Illinois U. Library

SCIENCE ABSTRACTS: SECTION A 7932–8545

OLUME 59

PHYSICS ABSTRACTS

UMBER 707

OVEMBER 1956

Published by The Institution of Electrical Engineers

SECTION A OF SCIENCE ABSTRACTS *(Section B: Electrical Engineering)*

Edited and issued by THE INSTITUTION OF ELECTRICAL ENGINEERS, Savoy Place, London, W.C.2

Published monthly in association with THE PHYSICAL SOCIETY, THE INSTITUTE OF PHYSICS, THE AMERICAN PHYSICAL SOCIETY, AND THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Co-operating member of the I.C.S.U. Abstracting Board (International Council of Scientific Unions)

Physics Abstracts

CONTENTS

	PAGE
MATHEMATICS	871
ASTRONOMY. ASTROPHYSICS GEODESY	871
PHYSICS	873
Fundamentals	873
General mechanics. Mechanics of solids	879
Mechanical measurements	879
Mechanics of fluids	879
Capillarity	—
Molecular theory of liquids	880
Mechanics of gases	881
Molecular theory of gases	882
Vibrations. Acoustics	882
Optics. Radiation. Spectra	886
Heat	894
Thermodynamics	895
Electricity	896
Electrostatics. Dielectrics	896
Electric conduction. Currents	898
Electric discharges	903
X-rays	904
Cathode rays. Positive rays	904
Discharge tubes. Counters	906
Ionization. Thermionics	908
Cosmic rays	908
Magnetism	909
Electromagnetism. Electrodynamics	911
Electromagnetic waves and oscillators	911
Molecular and atomic structure	913
Theory of solid state	913
Molecules	913
Atoms. Nucleus. Isotopes	915
Radioactivity. α-, β- and γ-rays	917
Nuclear reactions	920
Atom and molecular beams. Mesons. Neutrons	924
Structure of solids	926
Elasticity. Strength. Rheology	928
PHYSICAL CHEMISTRY	929
Phase equilibrium. Chemical reactions	929
Electrochemistry	929
Photochemistry. Radiation chemistry	930
Dispersions. Colloids. Adsorption	930
Chemical structure	930
Chemical analysis	931
CRYSTALLOGRAPHY	931
Atomic and X-ray crystallography	932
GEOPHYSICS	935
Atmosphere. Meteorology	935
BIOLOGY	941
Medical science. Human physiology	941
TECHNIQUE. MATERIALS	942
Photography	942

The number printed above each abstract on the right is the Universal Decimal subject classification number; the abstracts are arranged in order of these numbers throughout each issue.

The monthly Author Index, List of Journals, Errata and Notes follow immediately after the last page of abstracts.

RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Lines and networks
Waveguides
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Oscillators. Pulse circuits
Amplifiers
Electroacoustic apparatus
Radiocommunication
Mechanical engineering
Illumination

Committee of Management

THE INSTITUTION OF ELECTRICAL ENGINEERS
THE PRESIDENT (*ex officio*)
L. G. BRAZIER, Ph.D., B.Sc., M.I.E.E.
J. A. BROUGHALL, B.Sc.(Eng.), M.I.E.E.
L. HARTSHORN, D.Sc., M.I.E.E.
R. L. SMITH-ROSE, C.B.E., D.Sc., M.I.E.E.

THE PHYSICAL SOCIETY
J. H. AWBERY, B.A., B.Sc.
R. C. EVANS, M.A., Ph.D., B.Sc.
D. ROAF, M.A., D.Phil.
MISS A. C. STICKLAND, M.Sc., Ph.D.

THE INSTITUTE OF PHYSICS
E. R. DAVIES, O.B.E., F.Inst.P.

THE ROYAL SOCIETY
T. E. ALLIBONE, D.Sc., Ph.D., M.I.E.E., F.R.S.

THE CENTRAL ELECTRICITY AUTHORITY
L. W. JAMES, M.A., A.M.I.E.E.

OBSERVER FOR THE AMERICAN PHYSICAL SOCIETY
D. M. GATES, B.S., M.S., Ph.D.

Editorial

EDITOR
B. M. CROWTHER, M.A., Ph.D., F.Inst.P.

ASSISTANT EDITORS
N. R. FOWLER, A.R.C.S., D.I.C., F.Inst.P.
R. W. PRIOR.
A. TYBULEWICZ, B.Sc.

Annual Subscriptions

Section A, £4 10 0; Section B, £3 10 0; both sections, £7 10 0.

Printed on one side only, for mounting on cards (indexes on request only):

Section A, £5 10 0; Section B, £4 10 0; both sections, £9 10 0.

Copyright. All rights reserved.

PHYSICS ABSTRACTS

Volume 59 NOVEMBER 1956 Number 707

MATHEMATICS 51

517.54 : 538.31 : 621.317.329

7932. USE OF THE METHOD OF CONFORMAL TRANSFORMATIONS FOR MODELLING THREE-DIMENSIONAL POTENTIAL AND EDDY FIELDS. P.M.Egorov'.
Elektrichestvo, 1956, No. 5, 31-8. In Russian.

The analogy between fields with planar meridians and plane-parallel fields in an inhomogeneous medium enables the method of conformal transformations to be applied to the investigation of three-dimensional fields. These problems arise in electron optics, high-frequency heating of steels for hardening purposes, h.v. insulator and transformer design, etc. Such fields are best investigated with models which are obtained by taking wedge-shaped sections of solids of rotation, bounded by two meridional planes intersecting in the axis. The tank itself is of flat shape, but in a sloping position, so that the electrolyte introduced forms a wedge-shaped layer. In the case of severely inhomogeneous fields or very long fields, there are difficulties which can be overcome, as is shown, by the use of conformal transformations. This leads to the construction of "universal models" by means of which an experimental "conversion" of fields with plane meridians into plane-parallel fields, conserving the contours of the original field, is possible. Such models are also useful for the investigation of severely inhomogeneous two-dimensional fields. Also, the method can be used for work on an integrator of the type embodying lattices consisting of electrical resistance wires. B.F.Kraus

518.5

7933. APPLICATIONS OF A TRANSFORMER ANALOGUE COMPUTER. J.R.Barker.
Brit. J. appl. Phys., Vol. 7, No. 8, 303-7 (Aug., 1956).

The Blackburn analyser is a versatile transformer analogue computer well-known among electrical-power engineers as an a.c. network analyser. This paper shows that it can be used to solve many algebraic problems involving real or complex numbers. Among these are the extraction of the latent roots of matrices, the location of the zeros of polynomials, and the solution of linear and non-linear simultaneous equations. A.

519.2 : 537.542

7934. ON A PROBABILITY PROBLEM ARISING IN THE THEORY OF COUNTERS. L.Takàcs.
Proc. Cambridge Phil. Soc., Vol. 52, Pt 3, 488-98 (1956).

Contains some remarks on the problems treated by Hammersley (Abstr. 549/1954). With the aid of a new and simple method the exact solutions of Hammersley's problems and the asymptotic behaviour of the solutions are found. The problems in question are: A Poisson process is transformed into a new process by a Type II counter, and this new process is transformed again by a Type I counter. The distribution of the number of events occurring in each transformed sequence is to be determined. A.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.11

7935. ON THE SIGNIFICANCE OF NEWTONIAN COSMOLOGY. W.H.McCrea.
Astron. J., Vol. 60, No. 7, 271-4 (Aug., 1955).

The theory of Newtonian cosmology is re-examined in the light of criticisms by D.Layzer. His two theorems concerning Einstein's law of gravitation substantiate the significance that was assigned to the theory by Milne and McCrea. However, in order to provide analogues of the relativistic models that are Newtonian in the strictest possible sense, the theory has to be formulated in terms of a bounded system. But, since this may be arbitrarily large, the distinction between it and an unbounded system is physically scarely significant. Any extension to an unbounded system necessitates some extension of the definition of Newtonian gravitation. Layzer's criticisms make this clear and bring out the difficulty of formulating a satisfactory extension. Nevertheless the extension that he criticises in particular is self-consistent and is the appropriate one in the context. A.

523.11

7936. POPULATIONS AND EVOLUTION OF STARS. M.Taketani, T.Hatanaka and S.Obi.
Progr. theor. Phys., Vol. 15, No. 2, 89-94 (Feb., 1956).

A scheme was proposed for the whole evolutionary process of celestial objects and the observational characteristics between two populations, Populations I and II are discussed in some detail. It is suggested that these characteristics can be accounted for by the present scheme. A.

523.161

7937. THE DISTRIBUTION OF INTERSTELLAR GAS. B.Donn.
Astron. J., Vol. 60, No. 7, 237-46 (Aug., 1955).

Methods are developed for correcting the predictions of the random cloud model for unresolved blends, enabling a careful comparison between Adams' observations and hypothetical models to be made. This indicates that satisfactory agreement with the observations on frequency of multiple components or distribution of radial velocities cannot be obtained by choice of cloud frequency and velocity dispersion. Also Adams' relation between line intensity and velocity turns out to be incapable of explanation. These appear to be fundamental difficulties, characteristic of any hypothesis of small random clouds. A revised hypothesis is proposed in which there is a continuous distribution of gas having statistical density fluctuations; the entire mass, however, partakes of the galactic rotation. This gives rise to single or primary components; secondary components are caused by high-velocity currents within the main mass. A.

523.161

7938. DIFFUSION COEFFICIENT OF PARTICLES IN A MAGNETIZED INTERSTELLAR MEDIUM. A.A.Logunov and Ya. P.Terletskiĭ.
Zh. éksper. teor. Fiz., Vol. 29, No. 5 (11), 701-2 (1955). In Russian. English translation in Soviet Physics JETP (New York), Vol. 2, No. 2, 353-4 (March, 1956).

A discussion of the dependence of the diffusion coefficient on particle energy. R.A.Newing

523.164.42

7939. A PRELIMINARY STUDY OF THE MAGNITUDE DISTRIBUTION OF CELESTIAL RADIO SOURCES. J.D.Kraus.
Astron. J., Vol. 60, No. 10, 398-400 (Nov., 1955).

Counts of celestial radio sources as a function of magnitude are compared with visual star counts and with the increase per magnitude to be expected for a uniform distribution. The radio counts are based on four published lists the largest having 207 sources. Although this number is perhaps too small to draw definite conclusions, the radio and visual-count curves differ significantly and some of the implications of this difference are considered. The need for longer lists of radio sources is pointed out and the increase in the number of observable radio sources to be expected for a given increase in aerial aperture is discussed. A.

523.164.85

7940. RADAR-ECHO DURATION AND HEIGHT OF A PERSEID METEOR. D.W.R.McKinley.
J. atmos. terrest. Phys., Vol. 8, No. 1-2, 76-82 (Feb., 1956).

Three-station radar observations of an unusual Perseid meteor echo have yielded a height-duration profile of the echo components, with an overall duration of 549 sec. The main part of the enduring echo, at a mean height of 91 km, drifted in an easterly direction at a rate of 119 m/sec. The meteoric velocity and deceleration are discussed briefly. Of special interest is the appearance of diffuse echo components which have been due either to direct reflections from meteoric ionization created over the height range 130-160 km, or to ground scatter via the main part of the meteoric ionization. A.

523.165 : 537.591

7941. SUPERNOVA ORIGIN OF COSMIC RAYS. S.Hayakawa.
Progr. theor. Phys., Vol. 15, No. 2, 111-21 (Feb., 1956).

The supernova origin of cosmic rays is proposed in connection with the stellar evalution and the building up of heavy elements in the core of stars as they evolve. Nearly equal abundances of heavy and medium nuclei in primary cosmic rays suggest that the sources may be such stars, in which the thermonuclear reactions of building up heavy elements take place and which eventually explode as supernovae. The light elements, Li, Be and B, in galactic matter are considered to be generated by the nuclear bombardment of heavier nuclei at the explosion. The number of cosmic-ray particles injected there is estimated in reference to the radio emission of supernova remnants. If the number injected is of the order of 10^{51} per supernova and the explosion is more frequent than now observed, the supernova origin is shown to be not inconsistent with cosmic ray as well as astronomical evidence. The galactic model suitable to this interpretation is a sphere with magnetic clouds. The life time of cosmic rays in this galaxy is estimated to be of the order of 10^8 years, corresponding to the fact that the mean thickness of interstellar matter traversed by cosmic rays is about 1 g cm^{-2}, that is estimated from the abundance of the light nuclei in the primary cosmic rays. A.

523.59

7942. ORIGIN OF THE ZODIACAL LIGHT AND THE VARIATIONS OF ITS BRIGHTNESS. P.K.Sengupta.
Indian J. Phys., Vol. 30, No. 3, 285-91 (June, 1956).

It has been suggested that the zodiacal light originates from the scattering of photospheric radiation by electrons and interplanetary dust particles lying within an ellipsoidal volume in the interplanetary space with the sun as its centre. The corpuscles in the solar corpuscular stream, leaving the sun with velocities less than the velocity of escape and carrying the interplanetary dust particles with them, form the ellipsoida volume with the rotation of the sun, and account for the lenticu lar shape of the zodiacal light and the varying inclinations of its light axis with the plane of the ecliptic in different seasons. The variations of the intensities during magnetic storms and with the advent of meteor swarms are satisfactorily explained with the help of the above picture, as due to the augmentations in the number of electrons in the solar corpuscular stream and the number of dust particles respectively. A.

523.67 : 535.333

ANALYSIS OF THE SPECTRUM OF AMMONIA AND THE SPECTRA OF COMETS. See Abstr. 7273

523.72 : 537.591.5

COSMIC RADIATION FROM THE SUN. See Abstr. 7504

523.74

7943. PREDICTION OF SOLAR ACTIVITY. K.Urbanik and A.Zięba.
Arch. elektrotech. (Warsaw), Vol. 5, No. 2, 355-64 (1956). In Polish.

Changes in electromagnetic solar activity which cause disturbances in radio reception are characterized in a general manner by Wolf numbers. These numbers describe the location and number of sunspots. It is assumed that the change in the Wolf numbers with time is of chance nature. In this paper probability methods for predicting Wolf numbers are briefly discussed. For the Kolmogorov–Wiener linear method of prediction the greater the amount of data employed, the better the results. A great quantity of observed data, however, lead to long and time-consuming calculations. A prediction method based on the theory of decision functions, employing not too great quantitative data and giving relatively good results is described. The cost of the experiment has also been taken into account. A

523.745 : 550.385 : 537.591.5

CORRELATION AMONG MAGNETIC STORMS, SOLAR PHENOMENA AND COSMIC-RAY STORMS. See Abstr. 7507

523.745 : 551.510.53

7944. A NEW INDEX OF SOLAR ACTIVITY BASED ON IONOSPHERIC MEASUREMENTS. C.M.Minnis.
J. atmos. terrest. Phys., Vol. 7, No. 6, 310-21 (Dec., 1955).

The monthly mean relative sunspot number (R_M) is assumed to contain a component (R_V) which has a one-to-one correlation with the critical frequency of the F_2-layer in an undisturbed ionosphere and which is, therefore, an idealized index of solar activity. The residual component (R_X) may be regarded as an error which has a standard deviation of about 20%. A new index (I_{F_2}) has been constructed for the period 1938-1954; like R_M, it can also be regarded as giving an approximate value of R_V, but its residual error component (R has a standard deviation which is only about one tenth that of R_X. The magnitude of I_{F_2} for a given month is computed from the mean noon critical frequencies in the F_2-layer at Slough, Huancayo, and Watheroo, which are normally available within a few weeks of the end of each month. The index is based, in effect, on a calibration of the F_2-layer critical frequencies at these observatories in terms of R_V, using data extending back as far as possible. Precautions have been taken to reduce to negligible proportions the effects of ionospheric disturbances on the magnitude of the new index. A

523.75

7945. THE RADIATION FIELD OF THE TRANSITION LAYER BETWEEN CHROMOSPHERE AND CORONA. L.Oste
Z. Astrophys., Vol. 40, No. 1, 28-64 (1956). In German.

Two empirical models are used to investigate the boundary conditions, with assumed electron temperatures of 1.6 x 10^6 °K for corona, and 4.0 x 10^3 °K for chromosphere. Estimates of radiation temperature, derived from intensities of the first five H, He I, and He II lines in the Lyman region, are 7000, 10 000, and 22 000° K respectively. The computed value of incident Lyman α-radiation per unit area cross-section at the earth's distance viz. about 1 erg/cm^{2}sec is in agreement with recent rocket data. Consideration is given also to the influence of chromospheric inhomogeneity (spicule formation) on the emission levels of He II and Ca II in the flash spectrum. D.R.Barber

PHYSICS 53

53.087 : 535.617

PRESENTATION OF 3-DIMENSIONAL OR 3-COMPONENT PHYSICAL MEASUREMENTS BY MEANS OF COLOUR DIAGRAMS. See Abstr. 7333

FUNDAMENTALS 530.1

530.12

7946. RESULTS OF GRAVITATIONAL SIGNIFICANCE IN RIEMANNIAN GEOMETRY. V.V Narlikar.
Nature (London), Vol. 177, 1138 (June 16, 1956).

It is noted that for an Einstein space in which $R_{ij} = \lambda g_{ij}$, the cosmological constant λ may be expressed as $a^n(a^m;_{mn} - a^m;_{nm})/a^k a_k$, where a^m is an arbitrary vector field. R.A.Newing

530.12

7947. ON BOUNDARY CONDITIONS IN THE NON-SYMMETRIC UNIFIED FIELD THEORY. M.Ikeda.
Progr. theor. Phys., Vol. 15, No. 1, 1-11 (Jan., 1956).

These are studied from the covariant point of view. The covariant expression of spatial infinity is obtained by generalizing the one ordinarily used in physics. A new boundary condition is proposed which is covariant for arbitrary coordinate transformations and reduces in a special case to the ordinary condition in general relativity. The newly-proposed condition is compared with the non-covariant one which has been employed by many authors. For the static solutions of the field equations in the electric or magnetic case, the new condition is shown to be equivalent to those which were proposed previously, using the scalar potentials. A.

530.12

7948. THE SCHWARZSCHILD SOLUTION IN DE DONDER'S COORDINATES. H.J.Meister and A.Papapetrou.
Z. Phys., Vol. 145, No. 4, 403-11 (1956). In German.

The static spherically symmetric solution subject to de Donder's coordinate condition involves a constant C_1 in addition to the total mass of the central body. C_1 depends upon the internal structure of the body and is determined in the weak-field case by obtaining a second-order approximation to the internal gravitational field. R.A.Newing

530.12 : 523.11

7949. INERTIAL PATHS IN GODEL'S COSMOLOGICAL MODEL. W.Kundt.
Z. Phys., Vol. 145, No. 5, 611-20 (1956). In German.

The geodesic equations are integrated and the motion of a test particle relative to an observer moving with the substratum is discussed. R.A.Newing

530.145

7950. EXTENSION OF DAVISON'S PARAMETRIC METHOD TO THE CASE OF KINETIC POTENTIALS. R.Cirelli and M.Pusterla.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 150-3 (July, 1956). In Italian.

The authors use an extension of Davison's method to treat the case of a charged particle in a uniform magnetic field, and state that the method can be used to define uniquely the Green's function for a particle in a uniform magnetic field and any electrostatic field whatever. J.M.Radcliffe

530.145

7951. ON THE FIELD THEORY IN FUNCTIONAL FORM. K.Yamazaki.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 141-4 (July, 1956).

The general expression for a propagator as a functional integral over Bose fields is rederived from the canonical formalism. P.T.Matthews

530.145

7952. A DISCUSSION ON BILOCALITY. J.Rayski.
Acta phys. Polon., Vol. 15, No. 2, 89-109 (1956).

The conceptual situation in contemporary theoretical physics is discussed. The position and displacement rectors x_μ, d_μ form an abstract algebra constituting a natural generalization of the concept of space-time (space-time quantization), and a starting point for a bilocal theory. The canonical transformations of the operators x_μ, d_μ play an important role. The linear subgroup of the group of canonical transformations is unimodular. This offers a simple and natural interpretation of isospin. The problem of rest-mass is also discussed. Mass consists of two parts: a kinetic (mechanical) mass and a field mass. The former is connected with the internal motion of the bipoint particle. For higher states of internal motion the self-mass is probably negligible in comparison with the kinetic mass. A.

530.145

7953. A VARIATIONAL PRINCIPLE FOR BILOCAL FIELD THEORY. J.Rayski.
Acta phys. Polon., Vol. 15, No. 2, 123-27 (1956).

The generalized Schrödinger–Gordon–Fock equations of the bilocal field theory are derived as the Euler–Lagrange equations of a suitably formulated variational principle. A.

530.145

7954. ON REPRESENTATION OF GREEN–SCHWINGER FUNCTIONS BY MEANS OF FUNCTIONAL INTEGRALS. N.N.Bogolyubov.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 2, 225-6 (1954). In Russian.

It is shown that functional integrals of the kind introduced by Feynman (Abstr. 1601/1951) constitute a formal solution of the equations of a quantized field theory.
Mathematical Reviews

530.145

7955. ON THE THEORY OF MULTIPLICATION OF CAUSAL FUNCTIONS. N.N.Bogolyubov and O.S.Parasyuk.
Dokl. Akad. Nauk SSSR, Vol. 100, No. 1, 25-8 (1955). In Russian.

An attempt is made to establish a precise mathematical meaning for the integrals over products of singular functions which always appear in solutions of the equations of quantum field theory. The singular functions are given a rigorous de-

finition as linear functionals over a wider class of functions than that used to define Schwartzian distributions.
Mathematical Reviews

530.145

7956. ON THE SUBTRACTIVE FORMALISM IN MULTIPLICATION OF CAUSAL SINGULAR FUNCTIONS.
N.N.Bogolyubov and O.S.Parasyuk.
Dokl. Akad. Nauk SSSR, Vol. 100, No. 3, 429-32 (1955). In Russian.
A continuation of the detail of the previous paper (see preceding abstract). Mathematical Reviews

530.145

7957. ON THE THEORY OF CAUSAL SINGULAR FUNCTIONS. O.S.Parasyuk.
Dokl. Akad. Nauk SSSR, Vol. 100, No. 4, 643-5 (1955). In Russian.
The results of the two previous papers (see two preceding abstracts) are used to justify rigorously the process of regularization in quantum field theory. Mathematical Reviews

530.145

7958. ON THE INTRODUCTION OF DYNAMICAL VARIABLES IN QUANTUM FIELD THEORY. B.M.Stepanov.
Dokl. Akad. Nauk SSSR, Vol. 100, No. 5, 889-92 (1955). In Russian.
A purely formal discussion of the definition and of the transformation properties of dynamical variables in the "intermediate representation" of N.N.Bogolyubov (Abstr. 7928/1952). Mathematical Reviews

530.145

7959. FUNCTIONAL INTEGRATION IN QUANTUM FIELD THEORY. W.K.Burton and A.H.de Borde.
Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 254-69 (Aug., 1956).
The problem of constructing explicit definitions for the vacuum expectation values of time ordered products of field operators as functional integrals is discussed with particular reference to systems in which the Fermi fields are involved bilinearly in the Lagrange function. Whereas a pure Bose system is comparatively easy to treat in this way, the presence of Fermi fields involves a complication due to the occurrence of non-commuting quantities in the classical action function. A definition involving only two non-commuting quantities, and some illustrative examples are given. A.

530.145

7960. NON-LINEAR EFFECTS IN THE VACUUM POLARIZATION. A.Minguzzi.
Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 476-86 (Aug., 1956).
The vacuum polarization current arising from the superposition of a constant electromagnetic field $e \cdot h = 0, h^2 - e^2 > 0$, with a small arbitrarily varying field, has been investigated without resorting to a power series development in the constant field. The energy density of a photon field in the constant field is also given. A.

530.145

7961. VACUUM POLARIZATION AND PROTON-PROTON SCATTERING IN THE ^3P STATE. E.Eriksen, L.L.Foldy and W.Rarita.
Phys. Rev., Vol. 103, No. 3, 781-3 (Aug. 1, 1956).
The contribution of the vacuum polarization potential to the ^3P phase shift in proton–proton scattering has been calculated and employed to correct observed phase-shifts to obtain the phase shifts associated with the specifically nuclear ^3P potential between two protons. In the energy range from 2 to 5 MeV, about half the observed phase-shift can be attributed to vacuum polarization. From the results it is shown that if the potential between the two protons in both the ^1S and ^3P states is represented by a square well of range 2.6×10^{-13} cm, then the ^3P potential is opposite in sign (repulsive) and approximately 13% in magnitude relative to the ^1S potential. A.

530.145

7962. ON THE MASS REVERSAL IN THE QUANTIZED FIELD THEORY. T.Ouchi, K.Semba and M.Yonezawa.
Progr. theor. Phys., Vol. 14, No. 2, 172-3 (Aug., 1955).
Two types of mass reversal can be defined analagous to strong and weak time reversal. Restrictions on possible mixing of interactions are deduced. P.T.Matthews

530.145

7963. NOTE ON THE NON-PERTURBATION APPROACH TO QUANTUM FIELD THEORY. T.Goto and T.Imamura.
Progr. theor. Phys., Vol. 14, No.4, 396-7 (Oct., 1955).
Assuming commutability between operations such as integration, differentiation, and taking the limit, on the spectral function determining the complete photon propagator, it is shown that only trivial solutions to field theory exist. The implication is that the assumptions are not valid.
P.T.Matthews

530.145

7964. AN EXACTLY SOLUBLE EXAMPLE IN QUANTUM FIELD THEORY. S.Machida.
Progr. theor. Phys., Vol. 14, No. 4, 407-8 (Oct., 1955).
A model similar to that of Lee, but including a vacuum polarization effect, is constructed and solved exactly and leads to similar difficulties of negative probabilities and "ghost" states. P.T.Matthews

530.145

7965. NON-LINEAR EQUATIONS IN THE QUANTUM THEORY OF FIELDS. V.Ya.Faĭnberg.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 608-9 (1956)
In Russian.
Field equations as given by Low (Abstr. 3453/1955) are in the present note deduced from general relations which were found by Lehmann, Simanzik and Zimmermann (Abstr. 1510/1955). The author draws attention to difficulties which have to be overcome if Low's approach is to be pursued.
R.Eisenschitz

530.145

7966. ON THE REMOVAL OF INFINITIES IN QUANTUM ELECTRODYNAMICS. L.D.Landau, A.A.Abrikosov and I.M.Khalatnikov.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 3, 497-500 (1954). In Russian.
The first of several papers on the role of perturbation theory in quantum electrodynamics. This theory uses expansions in powers of $e^2 = 1/137$, and it is regarded as justifiable only when the coefficient of e^2 is finite and convergent. It is assumed that the theory will ultimately be modified for a distance less than a certain critical value a, and the programme is to develop a theory in powers of e^2, where $e^2 \log a$ is not treated as small. It is shown that the zero-order approximation is equivalent to a "ladder approximation" in which all Feynman diagrams in which two photon lines cross are neglected. L.S.Goddard

530.145

7967. AN ASYMPTOTIC EXPRESSION FOR THE GREEN FUNCTION OF AN ELECTRON IN QUANTUM ELECTRODYNAMICS. L.D.Landau, A.A.Abrikosov and I.M.Khalatnikov.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 4, 773-76 (1954). In Russian.
The integral equations of the previous paper (see preceding abstract) are discussed. Explicit solutions are obtained for the electron Green's functions, and it appears that with a suitable choice of gauge, the Green's functions are free from divergent renormalization coefficients.
Mathematical Reviews

530.145

7968. AN ASYMPTOTIC EXPRESSION FOR THE GREEN FUNCTION OF A PHOTON IN QUANTUM ELECTRODYNAMICS. L.D.Landau, A.A.Abrikosov and I.M.Khalatnikov.

Dokl. Akad. Nauk SSSR, Vol. 95, No. 6, 1177-80 (1954). In Russian.

The integral equation for the photon Green's function (see preceding two abstracts) is solved in the high-momentum limit. Mathematical Reviews

530.145

7969. THE MASS OF THE ELECTRON IN QUANTUM ELECTRODYNAMICS. L.D.Landau, A.A.Abrikosov and I.M.Khalatnikov.
Dokl. Akad. Nauk SSSR, Vol. 96, No. 2, 261-4 (1954). In Russian.

The method of previous papers (see preceding three abstracts) is applied to the electron mass-operator; it is shown that the electron mass is almost entirely electromagnetic in origin. Mathematical Reviews

530.145

7970. GREEN'S FUNCTIONS IN THE THEORY OF MESONS WITH A WEAK PSEUDOSCALAR COUPLING. A.A.Abrikosov, A.D.Galanin and I.M.Khalatnikov.
Dokl. Akad. Nauk SSSR, Vol. 97, No. 5, 793-6 (1954). In Russian.

The method developed earlier (see preceding four abstracts) is applied to symmetric pseudoscalar meson theory with pseudoscalar coupling, and expressions are obtained for the nucleon mass and the coupling constant. The results are similar to those obtained for quantum electrodynamics. Mathematical Reviews

530.145

7971. COUPLING OF NON-RELATIVISTIC PARTICLES WITH A QUANTIZED FIELD. I. THE EXCITON IN A VIBRATING POLAR CRYSTAL. H.Haken.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1230-53 (June, 1956). In German.

A variation method is used to determine the stationary states of an "exciton" in a vibrating lattice with arbitrary strength of coupling. It is pointed out that the method is also applicable to the problem of the interaction of nucleons via the meson field. W.E.Hepner

530.145

7972. RENORMALIZED DIRAC MAXWELL EQUATIONS. D.Sen.
Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 270-82 (Aug., 1956).

The Dirac Maxwell equations are reformulated by eliminating that part of the interaction term which contributes only to the mass and charge of the bare electron and then by replacing the bare mass and charge of the electron by its experimental mass and charge. Then it is shown that a renormalization scheme is contained within them. Two schemes for renormalization are described and it is shown that the first scheme, although not the same, follows the pattern of Dyson's renormalization programme. A.

530.145

7973. ON THE NUCLEON–NUCLEUS INTERACTION. W.E.Frahn.
Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 313-22 (Aug., 1956).

A phenomenological energy-dependent interaction is introduced to describe the modified propagation character of nucleons in nuclear matter and to account for the observed energy-dependence of the real part of the optical potential. A.

530.145

7974. ON THE UNIVERSAL INTERACTIONS. S.Oneda and A.Wakasa.
Nuclear Physics, Vol. 1, No. 6, 445-76 (May, 1956).

The possibility of explaining the complicated interactions between elementary particles in terms of universal interactions is discussed. Four types of interactions which seem to have a certain universal character are mentioned. They are: electromagnetic interaction (e-int.), strong baryon–meson interaction (G-int.), weak Fermi interaction (f-int.) and weak boson–fermion interaction (g-int.). The possibility of having the unique coupling constant g for the last case is investigated by the analysis of decays of hyperons and K_μ-meson allowing their spin values to be up to 3/2 spin and 1 respectively. The best fit is found in the derivative couplings between spin 1/2 fermions and spin 0 bosons, but the possibility of including higher spin values is not completely ruled out. From a speculative multiple particle theory of g-int., the space inversion parity of elementary particles is determined from their decay modes. With the object of decreasing the number of universal interactions, the elimination of g-int. through the other three possible universal ones is discussed. It is shown, however, that this cannot be possible without adding a more complicated structure to f-int. Thus, merely by considering the ratio of $\pi \to \mu + \nu$ and $\pi \to e + \nu$ decay, it is concluded that (i) the coupling types of f-int. are process dependent, as long as the same value of the coupling constant is wanted for f-int. The possible coupling types and their experimental tests are investigated. Moreover, it is shown that, in order to explain hyperon decays (ii) f-int. must be extended to four baryon (not neutrino) processes. Under the conditions (i) and (ii) there seems to remain, at present, still the possibility that g-reactions such as hyperon decays and $K_\mu \to \mu + \nu$ etc. can be explained by such an intermediation, if (iii) the correct $\pi \to \mu + \nu$ decay life-time is given by the same mechanism. If any of the conditions (i), (ii) and (iii) does not hold, the coexistence of the elementary g-int. is the simplest and the most natural assumption. It is also shown that by the intermediary of these universal interactions, the interesting K-meson-decay modes $K_{2\pi} \to \pi + \pi^0$ and $K_3 \to \mu$ (or e) $+ \nu + \pi^0$, can be the alternative decay modes of the same K-meson. In these discussions the perturbation treatments with regard to G-int. are avoided as much as possible. The elementarity of these interactions is briefly summarized and the existence of other sorts of interactions is referred to in connection with the existence of the κ-meson. All the formulae of the decay probabilities due to g-int. are collected, including those of spin 3/2 particles. A.

530.145

7975. RENORMALIZATION IN MESON THEORIES. J.C.Taylor.
Proc. Cambridge Phil. Soc., Vol. 52, Pt 3, 534-7 (1956).

By a generalization of methods recently applied in electrodynamics, it is proved that the "bare-particle" coupling constant in renormalizable meson theories becomes imaginary at infinite cut-off. Analytical assumptions made are discussed. A.

530.145

7976. RENORMALIZATION OF THE EQUATIONS OF THE NEW TAMM–DANCOFF METHOD. V.I.Ritus.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 965-7 (1956). In Russian.

In the one-meson approximation this can be carried out by a finite charge renormalization and does not lead to the introduction of new constants as proposed by Dalitz and Dyson [Abstr. 7702 (1955)]. G.E.Brown

530.145

7977. MASS RENORMALIZATION IN THE TAMM–DANCOFF METHOD. D.A.Kirzhnits.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 971-3 (1956). In Russian.

Consistent use of the δm counter-term in the equations of motion is made. G.E.Brown

530.145

7978. ON THE MASS SPECTRA FOR BOSONS. W.Hanus and J.Rayski.
Acta phys. Polon., Vol. 15, No. 2, 117-22 (1956).

Two different mass operators consistent with the bilocal theory are constructed for bosons. One of them seems to

apply to the pion family, the other (constructed with the aid of Duffin–Kemmer matrices) to the K-meson family (Θ^0-family). A.

530.145

7979. THE THEORY OF PARTICLES OF ARBITRARY ISOTOPIC SPIN AND THE METHOD OF FUSION. D.Ivanenko and G.Sokolik.
Dokl. Akad. Nauk SSSR, Vol. 97, No. 4, 635-7 (1954). In Russian.

De Broglie's method of fusion is extended to include isotopic as well as ordinary spin. An equation of Paris (Abstr. 2008/1954) is discussed as a particular case of the theory. Mathematical Reviews

530.145

7980. ON THE INTERACTION OF PARTICLES OF A NEW TYPE OF SPIN $\frac{1}{2}$ WITH AN EXTERNAL FIELD. Yu. M. Shirokov.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 5, 737-40 (1954). In Russian.

The equations of the author's 1954 paper are studied in detail in the case of spin $\frac{1}{2}$. The theory constructed is not different from the theory of ordinary Dirac particles with a non-local interaction having matrix elements between positive energy states only. Mathematical Reviews

530.145

7981. ON A NEW RELATIVISTIC EQUATION FOR THE ELECTRON PROPOSED BY ZAĬTSEV. R.Pappalardo.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 166-7 (July, 1956). In Italian.

Shows that there is a complete identity between Zaitsev's equation (Abstr. 7693/1955) and Dirac's. J.M.Radcliffe

530.145

7982. ELECTROMAGNETIC ANNIHILATION OF ANTIPROTONS. L.M.Brown and M.Peshkin.
Phys. Rev., Vol. 103, No. 3, 751-2 (Aug. 1, 1956).

The familiar model of a nucleon as a Dirac particle with Pauli anomalous magnetic moment is used to obtain cross-sections for antiproton annihilation into two photons, two electrons, or two muons. The two-photon lifetime of the n^1S_0 state of the proton-antiproton atom is $\cong 2 \times 10^{-15} n^3$ sec. A.

530.145

7983. GENERALIZATION OF THE METHOD OF SUPPLEMENTARY VARIABLES TO SYSTEMS COMPOSED OF TWO KINDS OF PARTICLES. Z.Galasiewicz.
Acta phys. Polon., Vol. 15, No. 1, 49-62 (1956).

The paper describes a generalization of the Zubarev method (Abstr. 754/1955). It is shown that the elementary excitations in a system composed of electrons and ions (interacting electrostatically) are of two types: a boson type and a fermion one. The boson-type excitation may be described as a system of oscillators vibrating with the frequency $\sqrt{(\omega_1^2 + \omega_2^2)}$, where ω_1 is the Langmuir frequency of the electron vibrations (vibrations of the electron plasma) and ω_2 is the Langmuir frequency of the ion vibrations (vibrations of the ion plasma). If one neglects the (Coulomb) interaction between the ions and electrons, the elementary boson-type excitations are given by two systems of oscillators vibrating with the frequencies ω_1 and ω_2. As $\sqrt{(\omega_1^2 + \omega_2^2)} < \omega_1 + \omega_2$, the energy of the zero-point oscillations in the case of non-negligible interaction between the ions and electrons is smaller than when this interaction is absent. The energy difference of both these zero-point oscillations may be considered as a measure of the binding energy of the system coming from the "long-range" Coulomb interaction (which is responsible for the boson-type excitations). This energy has been evaluated for Li, Na, and K and compared with the total binding energy calculated by other methods or found experimentally. The orders of magnitude are the same and the results of the author lie nearer to the experimental values as those following from the Hartree–Fock method. A.

530.145

7984. ON THE EQUIVALENCE OF THE ZUBAREV METHOD AND THE BOHM–PINES METHOD FOR SYSTEMS OF TWO TYPES OF PARTICLES. Z.Galasiewicz.
Acta phys. Polon., Vol. 15, No. 2, 79-87 (1956).

In this work the method presented by Bohm and Pines (Abstr. 1278/1954) for the collective description of systems of two types of particles (electrons and ions) has been generalized. The result is compared with the results previously obtained by the author (see preceding abstract) for the generalization of the Zubarev method of supplementary variables (Abstr. 754/1955) for the same case. The equivalence of both methods is shown. The unitary transformation which transforms the Hamiltonian obtained by one method into the Hamiltonian obtained by the other is given. A.

530.145

7985. NOTE ON THE NUCLEON SELF-ACTION IN THE CLASSICAL SCALAR MESON FIELD THEORY. J.Sawicki.
Acta phys. Hungar., Vol. 5, No. 4, 381-89 (1956).

The nucleon self-force terms in the equations of motion in the classical scalar meson field theory are evaluated for the case of a uniform circular motion for both the symmetric and retarded fields. The self-force is discussed for the two-body problem. A.

530.145

7986. RELATIVISTIC EFFECTS IN THE THEORY OF THE α-PARTICLE. M.A.Ziegler and G.Szamosi.
Acta phys. Hungar., Vol. 6, No. 1, 67-71 (1956).

The present article deals with the determination of the binding energy of the α-particle by means of a variational method. The one-particle eigenfunctions involving the variational parameter are of the oscillator type. A real scalar meson field is responsible for the nuclear interaction. The article takes into consideration the latest results of classical relativistic dynamics i.e. the repulsive and many-body forces. The values of g are found to be 7.36e and 31.4e. In the latter case the importance of the repulsive and manybody forces considerably increases. A.

530.145

7987. GREEN'S FUNCTIONS FOR THE INTERACTION OF NUCLEONS WITH MESONS. E.S.Fradkin.
Dokl. Akad. Nauk SSSR, Vol. 98, No. 1, 47-50 (1954). In Russian.

A complete formal solution is developed for the equations of the quantum field thoery of mesons and nucleons. The method is very similar to that of Edwards and Peierls (Abstr. 6281/1954) but was developed independently. Mathematical Reviews

530.145

7988. THE BASIC EQUATIONS OF MESODYNAMICS. D.D.Ivanenko and D.F Kurdgelaidze.
Dokl. Akad. Nauk SSSR, Vol. 96, No. 1, 39-42 (1954). In Russian.

The first part of the paper gives detailed examples of non linear terms in the Lagrangian arising from fourth-order Feynman processes. The second gives closed solutions of the equation $(\Box - k^2 - \lambda\phi^2)\phi = 0$ in terms of elliptic functions. The equation is "basic" in the sense that it is the simplest equation manifesting the type of non-linearity shown in the first part to be characteristic of meson theory. Mathematical Reviews

530.145

7989. ON POSITIVE DEFINITENESS OF THE ENERGY IN A THEORY WITH HIGHER DERIVATIVES. I.I.Tal'yanskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 97, No. 3, 433-6 (1954). In Russian.

A complex scalar field ϕ is considered, which satisfies the fourth-order wave equation $(\Box - \mu_1^2)(\Box - \mu_2^2)\phi = 0$.

Such a field avoids many of the divergence difficulties which arise with fields satisfying the usual second-order equation. A condition is found for the ϕ-field to be positive definite.
Mathematical Reviews

530.145

7990. ON THE THEORY OF THE VACUUM FUNCTIONAL. N.P.Klepikov.
Dokl. Akad. Nauk SSSR, Vol. 98, No. 6, 937-40 (1954). In Russian.

Following the ideas of Schwinger (Abstr. 64, 65/1952), functional differential equations are derived which are satisfied by the vacuum functional G of a quantized field theory. G is defined as the vacuum-to-vacuum matrix element of the S-matrix in the presence of external sources which are unknown functions of position in space—time. Mathematical Reviews

530.145

7991. ON THE PROBLEM OF INTERACTION OF TWO QUANTUM FIELDS. E.S.Fradkin.
Dokl. Akad. Nauk SSSR, Vol. 100, No. 5, 897-900 (1955). In Russian.

Explicit formal solutions by means of functional integrals are obtained for the equations of the quantum field theory of nucleons and mesons with pseudoscalar interaction.
Mathematical Reviews

530.145

7992. ON THE THEORY OF THE DYNAMICALLY DEFORMABLE FORM FACTOR. M.Markov.
Dokl. Akad. Nauk SSSR, Vol. 101, No. 1, 51-4 (1955). In Russian.

A very general and preliminary discussion of methods of making interactions between elementary particles non-local, without introducing rigid structures defined by fixed form factors. The proposal is to make the form factor itself a dynamical part of the system, reacting to external forces in a causal way. A set of equations partially embodying this idea is presented.
Mathematical Reviews

530.145

7993. ON THE ANOMALOUS MAGNETIC MOMENTS OF THE NUCLEONS. S.P.Misra and B.B.Deo.
Indian J. Phys., Vol. 30, No. 1, 16-28 (Jan., 1956).

These have been calculated with the help of a fourth-order meson equation given by Bhabha and Thirring. The electromagnetic current density of this meson field has been evaluated for the purpose. The results are in much better agreement with the experiment that those obtained by conventional meson theories. A.

530.145

7994. MESON NUCLEON S SCATTERING AND CROSSING THEOREM. A.Martin.
Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 369-89 (Aug., 1956).

It is noticed that the low energy S wave calculations of meson—nucleon scattering cannot be very satisfactory if they do not obey the "crossing theorem". It may be interesting to modify the iteration treatments in order to satisfy the symmetry requirements. For this purpose the series of scattering processes considered is completed by a new series in which the initial meson and the final meson are exchanged. In this way, Levy's covariant treatment of S wave scattering is generalized. The result of the calculation is deeply modified by the introduction of these new processes. It is not possible to get a quantitative agreement with experiment. The signs of the phase shifts, however, are correct near $G^2/4\pi = 15$. The approximations used in solving the integral equations are discussed by comparison with other calculations. A.

530.145

7995. PERTURBATION TREATMENT OF THE NUCLEAR MANY-BODY PROBLEM. W.J.Swiatecki.
Phys. Rev., Vol. 103, No. 1, 265-6 (July 1, 1956).

The ratio of 1st to 2nd order perturbation theory for the binding energy, as a function of the density, is calculated for a two body Gaussian potential. For the observed density the correlation effects, over and above those arising from the exclusion principle, are small. P.T.Matthews

530.145

7996. A SINGULAR INTEGRAL EQUATION IN THE THEORY OF MESON—NUCLEON SCATTERING. R.H.Dalitz, M.K.Sundaresen and H.A.Bethe.
Proc. Cambridge Phil. Soc., Vol. 52, Pt 2, 251-72 (1956).

The Tamm—Dancoff theory of meson—nucleon scattering (pseudoscalar coupling) leads to a series of singular integral equations. The asymptotic behaviour of the solutions of these equations is obtained here for all scattering states. For attractive states there is a critical coupling constant beyond which no normalizable solutions exist for these equations; for repulsive states another critical coupling constant appears, beyond which the solutions oscillate infinitely often but are still normalizable. It is concluded that the renormalization procedures proposed previously (Abstr. 7702/1955) are consistent and successfully define finite vertex-functions, and that the equations obtained for these vertex-functions have satisfactory properties for numerical work. A.

530.145

7997. ON THE HEISENBERG'S NON-LINEAR MESON EQUATION. T.Taniuti.
Progr. theor. Phys., Vol. 14, No. 4, 408-9 (Oct., 1955).

The non-linear theory is solved for one dimensional motion for particles of zero mass on the basis of characteristic theory of partial differential equations. P.T.Matthews

530.145

7998. ON THE THEORIES OF HIGHER DERIVATIVE AND NON-LOCAL COUPLINGS. II. T.Taniuti.
Progr. theor. Phys., Vol. 15, No. 1, 19-36 (Jan., 1956).

For Pt I, see Abstr. 6346 (1956). It is generally granted that in theories of non-local couplings, the field equations (in mechanics, the equations of motion) are the integro-differential equations containing in their interaction terms an arbitrary function, the so-called form factor, and in Pt I these (c-number) equations were discussed, assuming the validity of the perturbation theory. In this paper, the convergency of the perturbation method is investigated and then it is shown that among the general solutions of these integro-differential equations, some special solutions can be constructed which tend to the solutions of free equations as the coupling constant approaches zero. It is, moreover, found that the motion specified by these special solutions conforms to the equations which are localized in the time-like direction and have as manifold solutions as free equations. Similar arguments are applied to theories of the higher derivative couplings whose formal solutions were constructed in Pt I. A.

530.145

7999. ON THE EXCHANGE MAGNETIC MOMENT OF THE TWO NUCLEON SYSTEM. S.Hatano and T.Kaneno.
Progr. theor. Phys., Vol. 15, No. 1, 63-73 (Jan., 1956).

The two-body exchange magnetic moment operators are calculated in the pseudoscalar meson theory with non-relativistic pseudovector coupling. The method of canonical transformation is used and results are obtained to the order of eg^4 in the power series expansion. The radial parts of all possible operators in the static approximation are given. The contributions of the exchange moment to the magnetic moment of the deuteron are calculated and it is found that in order to adjust the experimental moment $\mu r = 0.74$ should be taken as the lower limit in the radial integral. A.

530.145

8000. MESON REACTIONS IN TWO-NUCLEON SYSTEM. S.Minami.
Progr. theor. Phys., Vol. 15, No. 1, 12-18 (Jan., 1956).

With the charge-independence hypothesis, the meson–nucleon interaction in the two-nucleon system is studied by analysing the data of meson production in nucleon–nucleon collision and of meson–deuteron reaction. A.

530.145

8001. ON THE UNIVERSALITY OF THE WEAK INTERACTION. S.Ogawa.
Progr. theor. Phys., Vol. 15, No. 5, 487-94 (May, 1956).

With the object of understanding, from the unified point of view, weak interactions occurring in nature, a possible model is proposed. In this model new charged Bose fields are introduced and are assumed to interact universally with all Fermi particles. The difference between this and the other viewpoint, in which all weak interactions are assumed to come from the universal Fermi interaction, is discussed. A.

530.145

8002. APPLICATION OF SINGULAR INTEGRAL EQUATION THEORY TO PROBLEMS OF SCATTERING OF PARTICLES IN AN EXTERNAL FIELD. N.P.Klepikov.
Zh. éksper. teor. Fiz., Vol. 30, No. 4, 701-6 (1956). In Russian.

It is shown that the singular integral equation theory can be used to calculate the scattering phases of particles in an external field. As an illustration scattering by a δ-potential is considered. A.

530.145

8003. GENERALIZED METHOD OF CALCULATION OF DAMPING IN RELATIVISTIC QUANTUM FIELD THEORY. V.I.Grigor'ev.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 873-80 (1956). In Russian.

An infinite system of equations is constructed, each of the equations describing a process with the creation and absorption of a definite number of particles. It is shown that the system is equivalent to the Tomonaga–Schwinger equation. The solution which is obtained by the method of successive substitutions leads in the case of the S-matrix to results which are a generalization of those of the damping theory. A.

530.145

8004. ENCLOSED QUANTUM MECHANICAL SYSTEMS. T.E.Hull and R.S.Julius.
Canad. J. Phys., Vol. 34, No. 9, 914-19 (Sept., 1956).

A brief description is given of the eigenvalue problems associated with enclosed quantum mechanical systems and of some attempts to deal with these problems. Another method is developed which leads to a general asymptotic formula for the eigenvalues. This formula yields a simple asymptotic approximation to the eigenvalue in each particular case, once the eigenfunction of the corresponding unrestricted system is known. A.

530.145

8005. COMPTON SCATTERING OF LIGHT BY ELECTRON. D.Basu and D.P.Sural.
Indian J. Phys., Vol. 30, No. 6, 265-72 (June, 1956).

The relative importance of the influence of spin and relativity on the decrease of the Compton scattering cross-section with increasing photon energy has been studied in the semi-relativistic approximation. A semirelativistic Hamiltonian in which the influence of spin can be treated with the Pauli theory has been constructed and the total scattering cross-section determined by the second-order perturbation method. The terms due to relativity and spin have appeared separately in the final result; the spin tends to increase the cross-section so that the influence of relativity effect is predominant in making the Compton scattering cross-section decrease with increasing energy. A.

530.145

8006. ON SOME SOLUTIONS OF GÜRSEY'S CONFORMAL-INVARIANT SPINOR WAVE EQUATION. F.Kortel.
Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 210-15 (Aug., 1956).

See Abstr. 4842 (1956). Some classical solutions of the equation are given. A.

530.145

8007. ON THE WAVE EQUATION FOR SPIN 1 IN HAMILTONIAN FORM. I.Fujiwara.
Progr. theor. Phys., Vol. 14, No. 2, 166-7 (Aug., 1955).

The wave equation of the vector meson is expressed in Hamiltonian form. The same problem has been considered by Schrödinger (Abstr. 4387/1955) and his results are compared with those here obtained. P.M.Davidson

530.145

8008. EXTENSIONS OF VARIATIONAL METHODS. II. TWO PARAMETER EIGENVALUE PROBLEM FOR THE DEUTERON STATE. T.Kikuta.
Progr. theor. Phys., Vol. 15, No. 1, 50-62 (Jan., 1956).

For Pt I, see Abstr. 6292 (1956). In the usual treatment of the deuteron problem, depths of both central and tensor potentials are to be determined so as to give the correct experimental values for the binding energy γ^2 and the electric quadrupole moment Q assuming a suitable function for the potential. We can consider these two depth values as "two parameter eigenvalue". In this connection the following approximate relation among Q, γ^2 and the mixing parameter ϵ of the D-state to the S-state is useful: $\tan\epsilon = -\sqrt{2}Q\gamma^2$, γ^2 =(binding energy of deuteron) x (nucleon mass) $\div \hbar^2$, which is shown to be accurate within 10%. The usual variational method is extended to this problem: The stationary expressions for both depths of central and tensor potentials are first found, and it is proved that the stationary requirement is equivalent to the fundamental equations of the deuteron state with specified mixing ratio ϵ. Actual applications are carried out for the square-well potentials. The most advantageous point of the present method is that both depths can be determined simultaneously without resource to an approximate method such as trial-and-error method. Lastly the variation principle corresponding to the Rayleigh–Ritz variational method is generalized to the many-parameter eigenvalue problem. A.

530.145

8009. CONCERNING THE CHOICE OF PHYSICALLY ACCEPTABLE SOLUTIONS OF THE SCHRÖDINGER EQUATION FOR THE HYDROGEN ATOM. T.Titts (Tietz).
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 948-9 (1956). In Russian.

Criteria for the choice of the correct solution in the case L = 0 are discussed. G.E.Brown

530.162

8010. THE STATISTICAL MECHANICAL ASPECT OF THE H-THEOREM. II. E.Teramoto.
Progr. theor. Phys., Vol. 15, No. 5, 480-6 (May, 1956).

For Pt I, see Abstr. 6434 (1956). Discusses, to some degree quantitatively, the properties of the H-function, especially its irreversible character, using the same model as that used in Pt I. It is concluded that the more roughly the macroscopic observation is done, the more rapidly the H-function decreases to an equilibrium value. Thus it is clarified that the H-function of a given system which is in a non-equilibrium situation should be defined in connection with the accuracy of macroscopic observations. In the calculations, no assumptions such as "Stosszahlansatz" or the coarse-graining in every moment of the process have been used, except once in setting up the ensemble which represents a given non-equilibrium initial state. The result gives a justification of the statistical aspect of the H-theorem, suggested by Ehrenfest without proof. A.

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.55

8011. OPTIMUM ROCKET TRAJECTORIES. B.D.Fried and J.M.Richardson.
J. appl. Phys., Vol. 27, No. 8, 955-61 (Aug., 1956).

Some general considerations regarding maximum range missile trajectories are presented. It is shown that under certain simplifying assumptions maximum range is achieved if the thrust attitude angle is held constant during the entire powered flight. This result is exact for a constant gravitational force field if aerodynamic forces and altitude dependence of rocket thrust are neglected. For motion in the earth's inverse square, central force field, constant thrust attitude is a good approximation to the optimum programme, provided the distance covered during powered flight is small compared to the radius of the earth. Equations for the value of the optimum attitude angle are presented for both constant and Kepler force fields. The results provide a convenient means of estimating an upper limit for the range which could be achieved with a given missile. A.

MECHANICAL MEASUREMENTS 531.7

531.7 : 535.617

MEASUREMENT OF PHYSICAL QUANTITIES BY MEANS OF COLOURS. See Abstr. 7333

531.711

8012. ADHESION AND CONTACT ERROR IN LENGTH METROLOGY. C.F.Bruce and B.S.Thornton.
J. appl. Phys., Vol. 27, No. 8, 853-9 (Aug., 1956).

An account is given of experimental studies of the nature of the strong adhesive contact between finely finished steel and glass surfaces when a trace of liquid exists between them. These surfaces are of the kind that are of practical use in length metrology where this adhesive action or "wringing" is of considerable importance. The dimensional effects of the thin film between the surfaces have been measured by multiple-beam interferometry and the nature of the adhesive contact has been further studied by measuring tangential forces and electrical characteristics. The experimental evidence suggests that there is no liquid film effectively separating the surfaces but that the strong adhesive action induced by the presence of the liquid introduces a dimensional contact error. This error is likely to be positive or negative, depending on the degree of contact between the surfaces. Provided the adhesion is good the contact error is not greater than $\pm 0.01\mu$. Where such an error is undesirable in high precision length metrology it is better to avoid the use of this adhesive contact. A.

531.713.8

8013. A PHOTOELECTRIC MICROSCOPE FOR THE MEASUREMENT OF LINEAR SCALES. J.S.Clark and A.H.Cook.
J. sci. Instrum., Vol. 33, No. 9, 341-7 (Sept., 1956).

A description is given of a photoelectric microscope which is suitable for the accurate measurement of linear scales of high precision. A real image of a graduation line, formed by means of an ordinary microscope objective, is caused to oscillate across a fixed slit in front of a photoelectric cell. A phase-sensitive rectifier determines when the mean position of the line image coincides with the centre line of the slit. When this is so, the d.c. output of the rectifier is zero and for small displacements of the mean position of the line image, the d.c. output — which is measured on a microammeter — is proportional to the displacement. The standard deviation of a single setting of the microscope is about 0.03μ and by associating the microscope with an interferometer, short linear scales have been measured directly in wavelengths with a standard deviation of about 0.1μ. It is thought that, with a properly designed interferometer to measure the displacement of a scale with respect to a fixed photoelectric microscope, a standard deviation of 0.05μ would be achieved. A.

531.717.1

8014. THE MEASUREMENT OF FILM THICKNESS WITH A PNEUMATIC HYPODERMIC NEEDLE MECHANISM. N.Stolow.
J. sci. Instrum., Vol. 33, No. 9, 333-7 (Sept., 1956).

An apparatus is described by means of which the measurement of film thickness may be made on supported polymer films in a non-destructive manner. This apparatus is based on the principle of flow of a gas, e.g. nitrogen, through the space formed by the tip of a cut-off hypodermic needle and a given surface. The theory, an extension of a previous one for a swelling measurement apparatus, is presented and appropriate sensitivity expressions are derived. Agreement with the theory is good except when the rate of flow parameter is high, and kinetic energy corrections must then be applied. The r.m.s. error in the location, at a fixed distance away, of a point on a surface is found to be $\pm 0.2\ \mu$. The films are ordinarily cast on optically selected flat-faced glass plates which are mounted on the flat base plate of the apparatus. By lateral sliding action of the support on the base plate, a number of surface locations are made on the film and around the film edge from which the mean film thickness is obtained. The r.m.s. error in the mean film thickness is found to be $\pm 0.4\ \mu$ for films ranging from $10\ \mu$ to greater than $200\ \mu$ in film thickness. A.

MECHANICS OF FLUIDS 532

532.14 : 532.133 : 532.612.4

8015. SOME PHYSICAL PROPERTIES OF PURE LIQUID OZONE AND OZONE—OXYGEN MIXTURES. A.C.Jenkins and F.S.DiPaolo.
J. chem. Phys., Vol. 25, No. 2, 296-301 (Aug., 1956).

The melting point of pure liquid ozone has been determined by two methods and found to be $-192.5 \pm 0.4^{\circ}$C. The surface tension of pure ozone at -182.7°C is 38.1 ± 0.2 dynes/cm. Densities of pure liquid ozone are as follows: 1.5727 ± 0.0004 g/cm^3 at -182.9°C, 1.5839 ± 0.0011 g/cm^3 at -185.6°C, and 1.6130 ± 0.0004 at -195.6°C, the last value being for the super-cooled liquid. The viscosity of pure liquid ozone is 1.56 ± 0.2 centipoises at -183.0°C and 4.14 ± 0.5 centipoises for the supercooled liquid at -195.6°C. Densities of several liquid ozone-oxygen mixtures have been measured. These measurements show that densities of liquid mixtures can be calculated accurately from densities of pure oxygen and ozone by the relation $1/d = x_1/d_1 + x_2/d_2$, where d is the density of the mixture, d_1 and d_2 are the densities, and x_1 and x_2 the weight fractions of pure oxygen and pure ozone, respectively, at the given temperature. Viscosities of ozone oxygen mixtures have been measured at -183.0°C and can be reproduced with an average deviation of 5% by the relation $\log_{10}\eta = x_1 \log_{10}\eta_1 + x_2 \log_{10}\eta_2$, where η represents the viscosity of the mixture, η_1 the viscosity of liquid oxygen, η_2 the viscosity of liquid ozone, and x_1 and x_2 are the mole fractions of oxygen and ozone, respectively, all at the same temperature. A.

532.51 : 530.145

8016. QUANTUM HYDRODYNAMICS FOR A CHARGED NON-VISCOUS FLUID. N.Mikoshiba.
Progr. theor. Phys., Vol. 13, No. 6, 627-8 (June, 1955).

Application of Ziman's method (Abstr. 6726/1953) to a charged fluid leads, at absolute zero, to the London equations of superconductors (irrotational momentum flow). At higher temperatures rotons appear which behave like excited bosons below the Bose—Einstein condensation point. Their electro-

dynamical significance is not clear, but it seems that in the absence of an electric field they merely reduce the number of the superconducting electrons in the usual manner.

H.London

532.516

8017. NON-STATIONARY FLOW OF VISCO-PLASTIC MEDIUM IN A CIRCULAR PIPE. N.V.Tyabin.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 3, 473-5 (1954). In Russian.

532.516

8018. APPROXIMATE SOLUTION OF THE PROBLEM OF NON-STATIONARY FLOW OF A VISCO-PLASTIC FLUID IN A CYLINDRICAL PIPE OF CIRCULAR CROSS-SECTION. A.Kh.Mirzadzhanzade and A.A.Abbasov.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 2, 249-51 (1956). In Russian.

The proposed procedure is based on N.A.Slezkin and S.M.Targ's approximate method (see Dokl. Akad. Nauk SSSR, Vol. 54, No. 3, 1946) and is claimed to be an improvement on N.V.Tyabin's solution (see preceding abstract), in that it employs core velocity and not average flow velocity in the criteria of similitude. A.Gelbtuch

532.517

8019. THE FLOW OF A VISCOUS LIQUID IN A CIRCULAR TUBE UNDER PRESSURE-GRADIENTS VARYING EXPONENTIALLY WITH TIME. L.Sanyal.
Indian J. Phys., Vol. 30, No. 2, 57-61 (Feb., 1956).

The flow under pressure-gradients proportional to $\exp(\nu\alpha^2 t)$ and $\exp(-\nu\alpha^2 t)$ is studied. It is found that when αR is very small (R radius of the tube) the motions in the two cases are similar, in the sense that the velocity distribution in a cross-section of the tube is parabolic in both the cases. But when αR is very large the two motions are completely different. In the first case the flow has the boundary-layer character while this characteristic is completely absent in the second case and the velocity depends on the wall distance. A.

532.529.7

8020. ON THE DEPOSITION OF DROPLETS FROM A STREAM (OF GAS). A.G.Amelin and M.I.Belyakov.
Dokl. Akad. Nauk SSSR, Vol. 108, No. 1, 31-3 (1956). In Russian.

The coefficient of droplet capture $\epsilon = M/Nvs\tau$ (where M = the number of droplets of a given diameter deposited on an object, s = the projection area in the direction of flow, N = the number of droplets of the given diameter per unit volume of the stream, v = the stream velocity, and τ = time) is a function of Stokes number S: $\epsilon = mS^n$. Experiments gave the following values for the leading edge of a cylinder: $m = 7 \times 10^{-6}$, $n = 3.5$ (within the range of S from 0.6 to 10); and for the trailing edge: $m = 2.66 \times 10^{-4}$, $n = 0.54$. At $S = 2.9$ equal amounts were deposited on both sides of the cylinder. A.Gelbtuch

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

8021. AN EXPERIMENTAL INVESTIGATION OF THE RELAXATION PROCESSES WHICH ARISE DURING THE PASSAGE OF ULTRASONIC WAVES THROUGH LIQUIDS. Yu.N.Bormosov, V.F.Nozdrev, V.D.Sobolev and A.M.Sultanov.
Akust. Zh., Vol. 2, No. 2, 118-23 (April-June, 1956). In Russian.

Experiments were carried out with methylacetate, ethylacetate, methylformate and ethylformate over a temperature range -40° to $+30^\circ$ C. A material was followed along a liquid–vapour saturation curve and studied by optical and by pulsed acoustic methods in the 1-30 Mc/s range, absorption of ultrasonic waves being measured throughout the temperature range including the critical region. Relaxation times and frequencies were determined, also specific heat, and the heat of activation. Possible mechanisms of the relaxation processes involved are discussed. C.R.S.Manders

532.7

8022. THE USE OF ULTRASONIC METHOD FOR STUDYING ORGANIC SUBSTANCES IN THE CRITICAL REGION. V.F.Nozdrev.
Akust. Zh., Vol. 2, No. 2, 199-204 (April-June, 1956). In Russian.

An absence of hysteresis phenomena is shown in the propagation of ultrasonic waves in the critical region of a liquid–vapour system. The possibility of using ultrasonic methods for determining critical temperature and density is discussed. It is shown experimentally that one of the basic sources of discrepancy in specific heat data obtained by direct and by ultrasonic methods is the occurrence of relaxation processes in the liquid–vapour critical region leading to a dependence of the specific heat upon the frequency of the ultrasonic waves. C.R.S.Manders

532.7 : 534.22

8023. VELOCITY OF SOUND AND INTERMOLECULAR FORCES IN LIQUID MIXTURES. J.P.Poupko.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 41, No. 9, 991-1009 (1955). In French.

A theoretical study of the factors influencing the velocity of sound in liquid mixtures both on Prigogine's theory of corresponding states, and on the cell model of liquids.

T.C.Toye

532.7

8024. IMPROVED FREE-VOLUME THEORY OF LIQUIDS. I. J.S.Dahler, J.O.Hirschfelder and H.C.Thacher, Jr.
J. chem. Phys., Vol. 25, No. 2, 249-60 (Aug., 1956).

To obtain practical results from the cell theories of liquids, it seems necessary to assume a simple symmetry for the distribution of a molecule about its lattice site. This is accomplished by replacing the interaction of the molecule with its neighbours by some "suitably averaged" interaction. In the Lennard-Jones and Devonshire treatment, the pair interaction is replaced by its spatial average. The authors find that a Boltzmann-type average is much more satisfactory. For an assumed symmetry of the distribution, the procedure provides an extension of Kirkwood's theory such that the resulting integral equation for the distribution function can be solved by numerical methods. The introduction of the Boltzmann-type averaging provides a pair wise correlation between the motions of molecules in neighbouring cells. These correlative effects have been neglected in previous cell theories of the liquid phase. Numerical calculations of the equation of state and thermodynamical properties are, at present, being carried out. In evaluating the integrals which arise in this development, the function L_0 defined by the double surface integral

$$\iint f(r_{12}, r_1, r_2, R)\, d\omega_1 d\omega_2 \Big/ \iint d\omega_1 d\omega_2 = \frac{1}{R} \int_{r_{12}(\min)}^{r_{12}(\max)} f(r_{12}, r_1, r_2, R) L_0(r_1/R, r_2/R, r_{12}/R)\, dr_{12}$$

has been found to be extremely useful. Here, r_1 and r_2 are the radii of two spheres, R the separation of their centres, r_{12} the separation of points on the two spheres, and f an arbitrary integrable function of r_{12}/R. L_0 is found to be a quadratic function of r_{12}, different for various subranges of the interval $[r_{12}(\max), r_{12}(\min)]$. For a variety of physical problems such as X-ray and electron diffraction, L_0 may have application. A.

532.7 : 539.185

8025. SCATTERING OF COLD NEUTRONS IN LIQUID METALS AND THE ENTROPY OF DISORDER. L.S.Kothari, K.S.Singwi and S.Visvanathan.
Phil. Mag. (Ser. 8), Vol. 1, No. 6, 560-7 (June, 1956).

Introducing a varying degree of disorder in Mott's quasi-crystalline model of liquid metals, the change in the cold neutron scattering cross-section on melting is calculated. Mott's calculations of the change in electric conductivity on melting have been repeated on the basis of this modified model using more recent data on the latent heat of fusion. It is shown that the change in the neutron scattering cross-section in lead and the change in conductivity in sodium and potassium on melting can be explained if we assume that the entropy of disorder on melting is nearly 0.5 R, R being the gas constant. That this value is of the right order of magnitude seems to be corroborated by self-diffusion data. A.

532.7

8026. THE CELL THEORY OF LIQUIDS. II. J.A.Barker.
Proc. Roy. Soc. A, Vol. 237, No. 1208, 63-74 (1956).

For Pt I, see Abstr. 6797 (1955). Numerical values of some integrals required in the refined cell theory of liquids are presented for the 12-6 potential in the critical region of density and temperature. The results show the importance of multiple occupation and correlation effects, and of the "smearing" approximation. Comparison of free energy curves derived from the theory with those for inert gases shows that consideration of binary correlations and multiple occupation of cells corrects the major part of the error of the simple cell theory. It is necessary to take correlations into account in determining multiple occupation factors. The theories of Barker and de Boer are compared; although they are both formally convergent, the theory of Barker appears to give better results in practice. A.

532.7 : 534.23

ULTRASONIC RELAXATION AND THE VIBRATIONAL SPECIFIC HEAT OF CARBON DISULPHIDE. See Abstr. 7222.

532.72

8027. SELF-DIFFUSION IN LIQUID ARGON. J.W.Corbett and J.H.Wang.
J. chem. Phys., Vol. 25, No. 3, 422-5 (Sept., 1956).

The self-diffusion coefficient of liquid argon was measured by the capillary technique. The average value of D at $84.31 \mp 0.13^{\circ}$K and 658 ∓ 12 mm of Hg is $(2.07 \mp 0.06) \times 10^{-5}$ cm^2/sec. A.

532.72

8028. THERMAL DIFFUSION IN LIQUIDS; THE EFFECT OF NON-IDEALITY AND ASSOCIATION. L.J.Tichacek, W.S.Kmak and H.G.Drickamer.
J. phys. Chem., Vol. 60, No. 5, 660-5 (May, 1956).

It is shown that the thermodynamics of irreversible processes, when appropriately applied to a system fixed in the laboratory, predicts that a thermal diffusion separation depends on the difference in the quantities $Q_i^{*'}/\bar{V}_i$, where $Q_i^{*'}$ is the molal net heat of transport and $\bar{V}_i$ is the partial molar volume. $Q_i^{*'}$ is related to the activation energy for motion by a physically logical argument and by a kinetic derivation. The results are applied to a series of binary solutions including one or more associated compounds. It is found that the activation energy for local expansion, $\Delta H_h^{\ddagger}$, is probably the part transported in molecular diffusion. The introduction of the "partial molar activation energy" is shown to predict the correct concentration dependence in thermal diffusion. The role of $X(\partial\mu/\partial X)$ in thermal diffusion is discussed. A.

532.77 : 535.557

8029. FLOW BIREFRINGENCE AND STRESS. W.Philippoff.
J. appl. Phys., Vol. 27, No. 9, 984-9 (Sept., 1956).

Simultaneous measurements of flow birefringence, shear and normal stresses on a 15% solution of polyisobutylene in decalin were performed. They proved that the extinction angle measured in birefringence is identical to the orientation of the principal tensile stress calculated from the normal stress measurements and that the birefringence was proportional to the difference in principal stresses in flow. A detailed discussion of the significance of this result is given with a possibility of a far-reaching generalization of the mechanical behaviour of high polymer solutions. A.

532.78 : 548.5

8030. THE DISTRIBUTION OF IMPURITY IN A SEMI-INFINITE SOLIDIFIED MELT. O.W.Memelink.
Philips Res. Rep., Vol.11, No.3, 183-9 (June, 1956).

The transient distribution of impurity in a solidifying melt is calculated for the case of a homogeneous initial impurity concentration and constant velocity of the solid-liquid interface. The assumptions involved are: (1) the fraction of impurity concentration segregating from the liquid at the interface is constant, (2) the transport of solute from and to the interface occurs by diffusion in the liquid of semi-infinite length. The transient distribution for various values of the segregation constant is evaluated numerically. A.

MECHANICS OF GASES 533

533.16

8031. THE VISCOSITY OF MIXTURES OF GASES AT HIGH TEMPERATURES. M.J.Kenney, R.J.Sarjant and M.W.Thring.
Brit. J. appl. Phys., Vol. 7, No. 9, 324-9 (Sept., 1956).

An accurate knowledge of the high temperature viscosity of mixtures of gases, such as the products of fuel combustion, is desirable for heat transfer calculations. The viscosities of mixtures of carbon dioxide and nitrogen were determined up to 900°C by a method in which the rate of fall of gas pressure in a closed, heated container is observed over a short period during which the gas is flowing out to the atmosphere along a heated capillary tube. A comparison is made between the experimental values obtained and those calculated for similar gas mixtures on the basis of a modern theory of transport coefficients. This comparison shows that it is possible to calculate the viscosities of gas mixtures at high temperatures with an accuracy of at least 2%. A.

533.5

8032. IONIZATION PUMPS. PUMPS USING EVAPORATION AND IONIZATION. E.Thomas.
Vide, Vol. 11, 88-98 (May-June, 1956). In French.

Reviews pumps where the ion pumping is predominant and those which utilize also gas gettering by a metal which evaporates continuously and condenses on a wall. A.

533.6.011.5

8033. PHYSICS OF GAS FLOW AT VERY HIGH SPEEDS.
Nature (London), Vol. 178, 343-5 (Aug. 18, 1956).

A discussion meeting of the Physical Society held in July 1956, dealing with chemical kinetics and fluid dynamics where speeds are so high that changes in kinetic energy are comparable with the energy required to produce physical changes such as dissociation, ionization and substantial emission of radiation. The implications for the aerodynamics of man-made projectiles travelling at extreme speeds, and also of meteors, were included in the discussion. The shock tube, the principal research tool in this field, was discussed, both as regards design and instrumentation, and in connection with the results so far discovered by its use.

MOLECULAR THEORY OF GASES 533.7

533.7 : 530.162

8034. PAIR CORRELATIONS IN DILUTE GASES AT LOW TEMPERATURES. J.M.Blatt.
Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 430-64 (Aug., 1956).

In classical statistical mechanics, the correlation function between pairs of gas particles in a dilute gas is given by $\exp[\beta V(r)]$, where $\beta = 1/kT$ and $V(r)$ is the potential of the force between the two particles. This paper presents the corresponding quantum mechanical formulae, including the generalization to Bose–Einstein and Fermi–Dirac statistics. The quantum mechanical corrections are of major importance in the low-temperature region, where they change the correlation function qualitatively. In the absence of bound states, the quantum pair correlation function approaches a finite limit as the temperature approaches zero. Various approximation methods are developed for the pair correlation function, including an application of a variation principle for the inverse of an operator, due to Friedman. A.

533.7

8035. THE SECOND VIRIAL COEFFICIENT NEAR ABSOLUTE ZERO. J.M.Blatt.
Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 465-75 (Aug., 1956).

A new proof of the quantum mechanical formula for the second virial coefficient is followed by a discussion of the behaviour of this coefficient in the limit of very low temperatures. Comparison is made with earlier work. A.

533.7 : 530.162

8036. THE STATISTICAL MECHANICS OF IMPERFECT POLAR GASES. I. SECOND VIRIAL COEFFICIENTS. A.D.Buckingham and J.A.Pople.
Trans Faraday Soc., Vol. 51, Pt 9, 1173-8 (Sept., 1955).

Deals with the forces between polar molecules and their relation to gas imperfection. In addition to the interaction of permanent dipoles, other directional intermolecular forces, such as dipole-induced dipole interaction, quadrupole forces and the effect of molecular shape may be important. These are discussed quantitatively and intermolecular potentials proposed to allow for them. Detailed expressions for the corresponding second virial coefficients are obtained from statistical mechanics and applied to experimental data for some polar gases. A.

533.7 : 530.162

8037. THE STATISTICAL MECHANICS OF IMPERFECT POLAR GASES. II. DIELECTRIC POLARIZATION. A.D.Buckingham and J.A.Pople.
Trans Faraday Soc., Vol. 51, Pt 9, 1179-83 (Sept., 1955).

The total dielectric polarization of a polar gas is expanded in inverse powers of the molar volume and the theoretical interpretation of the first term representing deviations from perfect gas behaviour is examined in detail. Calculations based on intermolecular fields proposed in Pt 1 suggest that dipole interactions should lead to an increase in the total polarization. The effect of other types of directional intermolecular force is examined. It is suggested that the observed decrease in the total polarization of methyl fluoride is due to the effect of molecular shape. A.

533.7 : 537.533.74

8038. SCATTERING OF ELECTRONS IN A LIQUID DUE TO VIOLATION OF LONG-RANGE ORDER. A.I.Gubanov.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 862-72 (1956). In Russian.

Further development of the zone theory of liquids proposed by the author is carried out by investigating the motion of electrons in a liquid in a rectangular coordinate system. Zero approximation wave functions are proposed which are similar to the Bloch functions for crystals and which satisfy equations which differ from the Schrödinger equation by small terms. Scattering of electrons in a liquid due to violation of long-range order in the atomic arrangement has been calculated and the dependence of the corresponding electron scattering mean free path on wave-number has been determined for small values of the wave-number. A.

VIBRATIONS. ACOUSTICS 534

534.13

8039. THE VIBRATION OF SEGMENTED BEAMS. J.P.Ellington.
Brit. J. appl. Phys., Vol. 7, No. 8, 299-303 (Aug., 1956).

The frequency equations and normal modes are obtained for the flexural oscillations of a light beam carrying equal and equally-spaced concentrated masses. The mass distribution in "lumped mass" approximation to a continuous beam is discussed. A.

534.131

8040. EFFECT OF PERIODIC SPATIALLY DISTRIBUTED FORCES ON THE VIBRATIONS OF MECHANICAL STRUCTURES. G.Hübner and E.Lübcke.
Z. Naturforsch., Vol. 11a, No. 6, 492-7 (1956). In German.

The differential equations and general solutions of the forced vibrations of a class of linear vibrator having an infinite number of degrees of freedom and damping proportional to the velocity are derived. The effect of sinusoidal forces applied in different directions on the vibrations of wires, rods, discs and circular arcs is discussed. For resonance to occur, the exciting frequency must be the same as the characteristic frequency of the system but it does not necessarily follow that resonance will always occur. Examples are given of the way in which only one, or all, of the characteristic frequencies of a system can be excited by different arrangements of the exciting forces. H.J.H.Starks

534.138

8041. ON THE LONGITUDINAL ATTRACTION AND REPULSION OF SPHERES IN VIBRATING AIR. B.Adamczyk and W.Staszewski.
Acta phys. Polon., Vol. 15, No. 1, 43-47 (1956).

The force acting on spheres in a Kundt's tube with their line of centres parallel to the tube axis has been investigated. It is shown that for the longitudinal position this force depends on the frequency and intensity of the air vibrations as well as on the size of the spheres. The force at very small distances is shown in some cases to be one of repulsion, so that Andrade's results cannot be generally true. A.

534.141 : 534.142

8042. AERO-THERMOACOUSTICS. (THE GENERATION OF SOUND BY TURBULENCE AND BY HEAT PROCESSES). O.K.Mawardi.
Rep. Progr. Phys., Vol. 19, 156-86 (1956).

An analysis of the general equations of motion of a viscous compressible fluid leads to the identification of three modes (vorticity, compression and entropy modes) of energy associated with the fluid. Interaction between these modes gives rise to acoustical phenomena, of which some are of great interest to the study of aircraft noises. The first part of this report deals with acoustical effects resulting from the interaction of a vorticity and a compression mode. It considers in detail the generation of sound from turbulence as encountered in a jet and in a boundary layer, and the scattering of sound from turbulence. In the remaining part the interaction of the entropy mode with the compression mode is discussed. Special emphasis has been placed on the study of heat-maintained vibrations as encountered in Rijke's phenomenon and in flame-driven oscillations. The article concludes with a speculative discussion of acoustical phenomena in which the couplings between the three modes are equally important. A.

534.213

8043. ON THE PROPAGATION OF "EXPONENTIALLY BOUNDED" WAVES OF FINITE AMPLITUDE H Ryffert.
Acta. phys. Polon., Vol. 14, No. 6, 435-45 (1955). In German.

Describes a mathematical investigation of the propagation of sound waves in an exponentially bounded medium. The problem is considered as unidimensional, making use of curvilinear coordinates. The sound waves are assumed to be penetrated by a small piston source situated at the narrow part of the exponential boundary. The motion of air in an exponential horn (for waves of infinitesimally small amplitude) is first considered, using conventional methods and equations. The results of the mathematical analysis enable an estimate to be made of the ratio of the intensity of the two waves of frequency ω and 2ω and the manner in which the amplitude decreases as the wave is propagated along the exponential horn. A.B.Wood

534.213

8044. FOCUSING OF SOUND WAVES BY NON-UNIFORM MEDIA. L.M.Brekhovskikh.
Akust. Zh., Vol. 2, No. 2, 124-32 (April-June, 1956). In Russian.

The field of a pointed radiator in a lamellar non-uniform medium is represented in an integral form in which reflection coefficients of plane waves occur. For sufficiently high frequencies coefficients of reflection can be calculated using the V.K.B. method. It is also possible to obtain, by a somewhat simpler procedure than in Haskell's paper (Abstr. 2462/1951), the equation of the caustic surfaces and to calculate the sound pressure near the cusp (examples given). C.R.S.Manders

534.213

8045. WAVEGUIDE PROPAGATION OF SOUND IN NON-UNIFORM MEDIA. Yu.L.Gazaryan.
Akust. Zh., Vol. 2, No. 2, 133-6 (April-June, 1956). In Russian.

A point spherical radiator, situated in a lamellar non-uniform medium, is considered and the field evaluated assuming the velocity of sound varies according to the Epstein law. C.R.S.Manders

534.213

8046. CORRELATION PROPERTIES OF A WAVE IN A MEDIUM WITH RANDOM HETEROGENEITIES. L.A.Chernov.
Akust. Zh., Vol. 2, No. 2, 211-16 (April-June, 1956). In Russian.

The work is complementary to that described in an earlier paper (Abstr. 4904/1956). The coefficient of the longitudinal space autocorrelation of amplitude and phase fluctuation is calculated. This autocorrelation is shown to extend to a distance considerably greater than for the transverse case. The coefficient of the time autocorrelation of fluctuations of amplitude and phase is also determined. The paper is entirely theoretical. C.R.S.Manders

534.213

8047. MAKING TRANSVERSE ULTRASONIC WAVES VISIBLE IN TRANSPARENT SOLIDS. V.G.Aver'yanova, V.I.Makarov and S.N.Rzhevkin.
Akust. Zh., Vol. 2, No. 2, 224-5 (April-June, 1956). In Russian.

Waves were set up in a flint glass block by means of an excited quartz plate. Using a Schlieren arrangement a photograph was obtained of standing transverse waves (λ = 3.28 mm, f = 805.6 kc/s, v = 2481 m/sec). By a slight change of frequency of excitation it was possible to show longitudinal waves (f = 808 kc/s, v = 4250 m/sec). A photograph is also given showing interference bands with reflection of ultrasonic waves of frequency 3520 kc/s at the glass–air boundary. C.R.S.Manders

534.213 : 532.51 : 537.533.72

8048. ON THE ELECTROMAGNETIC ANALOGY TO SOUND PROPAGATION. L.J.Laslett.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 724 (July, 1956).

Refers to a paper by R.H.Kraichnan (Abstr. 6820/1955) who has drawn attention to an interesting correspondence between the paths of sound rays in fluids undergoing shear flow and the trajectories of charged particles in magnetic fields. To establish the analogy it is assumed (i) the eddy size to be large compared with the sound wavelength and (ii) the velocity of the fluid flow to be small in comparison with the velocity of sound. Use is made of the Hamilton–Jacobi theory of particle dynamics and to the associated principles of Fermat and of least action. Extending Kraichnan's analysis, the author indicates how sound rays are influenced by the fluid motion. A.B.Wood

534.22

8049. A MODULATION METHOD OF MEASURING DISPERSIONS OF ULTRASOUND. V.A.Zverev.
Akust. Zh., Vol. 2, No. 2, 142-5 (April-June, 1956). In Russian.

The paper describes a method for the direct measurement of wave dispersion. During passage through a dispersing medium the character of the modulation in a wave alters and it is upon this that the measurements are based. Results of tests to find the possibilities of the method are given. C.R.S.Manders

534.22 : 532.7

8050. VELOCITY OF SOUND IN LIQUIDS, LIQUID MIXTURES AND SOLUTIONS. B.B.Kudryavtsev.
Akust. Zh., Vol. 2, No. 2, 167-72 (April-June, 1956). In Russian.

A new expression is obtained for the velocity of sound which contains the internal energy as well as the familiar characteristics of the substance. By means of this new expression the author is able to give an explanation of the observed variation with concentration of the velocities of sound in mixtures. The paper also deals with propagation in solutions and some values are calculated for the velocity of sound in aqueous solutions of electrolytes. Taking account of the known molecular association of water the theory is applied to the calculation of the velocity of sound in pure water at various temperatures. C.R.S.Manders

534.222.2

8051. PRECISION MEASUREMENT OF DETONATION VELOCITIES IN LIQUID AND SOLID EXPLOSIVES. A.W.Campbell, M.E.Malin, T.J.Boyd, Jr and J.A.Hull.
Rev. sci. Instrum., Vol. 27, No. 8, 567-74 (Aug., 1956).

A versatile chronographic technique for the measurement of detonation velocities in liquid and solid explosives is discussed. A raster-type oscilloscope is described which has a sweep linearity of 1% and a time coverage of 300 μsec. This instrument is composed of standard electronic componets and requires relatively little maintenance. The basic signal mixing circuits used to generate fast-rising pulses associated with the detonation of an explosive charge are briefly described. Some electrical effects associated with the detonation of an explosive charge are briefly described to point out a possible source of spurious signals. Techniques for the preparation and assembly of explosive charges are presented together with certain precautions which must be taken against the possibility of the generation of false signals. The effect of temperature on detonation velocities of liquid and solid explosives is mentioned. Using the techniques and precautions described, it is possible to obtain detonation velocity data with a precision of 0.1% or better. A.

534.23

8052. EXPERIMENTAL STUDY OF ULTRASONIC TRANSITION LAYERS. G.I.Kaminir and B.D.Tartakovskii.

Akust. Zh., Vol. 2, No. 2, 154-60 (April-June, 1956). In Russian.

The work deals with the acoustic analogue of "blooming" in optics. It is shown that a single layer can increase the coefficient of sound penetrability of an Al plate in water up to 99% and for steel up to 92%. The use of a double transition layer (as in optics) makes it possible to broaden the band of acoustic penetrability. Experimental work is described using frequencies of 0.5-2 Mc/s. Test surfaces were plane, cylindrical and spherical. Best results were obtained for layers of thickness $\lambda/4$. Layers of other metals, plastics or paint were used. C.R.S.Manders

534.23 : 532.7

8053. ULTRASONIC RELAXATION IN UNSATURATED ALDEHYDES. M.S.de Groot and J.Lamb.
Nature (London), Vol. 177, 1231 (June 30, 1956).

Previous work at frequencies up to 1 Mc/s showed decreases in α/f^2 with increasing frequency, indicative of relaxation, for crotonaldehyde and cinnamaldehyde but not for acrolein. The present work extends to 100 Mc/s and the curve shows a definite decrease in α/f^2 for acrolein, commencing at about 20 Mc/s. The work is now being extended above 100 Mc/s in order to determine the parameters for acrolein. T.C.Toye

534.23

8054. A PULSE METHOD OF FIXED SEPARATIONS, ITS PHYSICAL BASIS AND PRACTICAL APPLICATION. N.I.Koshkin, V.F.Nozdrev, V.D.Sobolev, M.G.Shirkevich and V.F.Yakovlev.
Akust. Zh., Vol. 2, No. 2, 161-6 (April-June, 1956). In Russian.

The apparatus is designed for the measurement of absorption of ultrasounds. Two fixed reflectors are set up in a tank and a quartz oscillator in a fixed position between them. Pulses are sent out towards the two reflectors and the amplitudes of the returning signals are compared. It is claimed that the authors' design allows measurements to be made not only more rapidly than with other methods, but also at high temperature and pressure and during phase transitions. Some results are given and compared with those for other methods. It is proposed that the equipment could be readily adapted for use as a control method. C R.S.Manders

534.23

8055. A DIFFERENTIAL METHOD OF MEASURING THE ABSORPTION OF ULTRASONIC WAVES IN LIQUIDS. I.G.Mikhallov and G.N.Feofanov.
Akust. Zh., Vol. 2, No. 2, 194-8 (1956). In Russian.

The paper describes a method for measuring small differences of absorption coefficient of a liquid in two vessels. Two quartz vibrators generate ultrasonic pulses of equal magnitude and duration. These pulses are propagated in two different vessels, one filled with a standard liquid and the other with the liquid under test. The signals reflected by the far walls of the two tanks are picked up by the vibrators and from a comparison of their magnitudes, knowing the absorption characteristics of one liquid, the absorption coefficient of the other can be derived. Sensitivity of the method was tested by having distilled water in the two tanks, one of which was held at a fixed temperature whilst the other was heated from 20-50° C. C.R.S.Manders

534.23 : 532.77

8056. MEASUREMENT OF ABSORPTION IN LIQUIDS BY ULTRASONIC INTERFEROMETRY. DETERMINATION OF THE INTRINSIC ABSORPTION OF A MACROMOLECULE IN SOLUTION. R.Cerf and E.Mayer.
C.R. Acad. Sci. (Paris), Vol. 243, No. 2, 148-51 (July 9, 1956). In French.

It is shown how measurements of resistances and impedances provide a rapid and sensitive method for the determination of absorption coefficients and hence the intrinsic absorption due to a macromolecule. T.C.Toye

534.23

8057. EFFECT OF COPPER ON ULTRASONIC ATTENUATION IN GERMANIUM. L.J.Teutonico, A.Granato and R.Truell.
Phys. Rev., Vol. 103, No. 3, 832-3 (Aug. 1, 1956).

The attenuation of compressional and transverse waves was measured in germanium single crystals for waves propagated in the ⟨100⟩ direction after heating at 800°C for 14 hr in a vacuum and after diffusion of Cu into the specimen. The attenuation decreased after the Cu treatment as was expected, possibly because the Cu atoms can pin the dislocations. W.Bardsley

534.23 : 534.321.9

8058. INVESTIGATION OF THE SCATTERING OF ULTRASONIC WAVES IN METALS. L.G.Merkulov.
Zh. tekh. Fiz., Vol. 26, No. 1, 64-75 (1956). In Russian.

Measurements of the attenuation of longitudinal and transverse ultrasonic waves (pulses at frequencies of 0.5-110 Mc/s lasting 2-10 μsec) in magnesium, iron and copper show that at $\lambda/\bar{D} \geq 10$ (where $\bar{D}$ is the mean grain diameter) the coefficient of sound scattering γ follows Rayleigh's rule $\gamma \sim \bar{D}^3 f^4$. At $\lambda/\bar{D} < 8$ to 10 this relationship changes to $\gamma \sim \bar{D} f^2$, and at $\lambda/\bar{D} \leq 4$ the sound scattering process begins to approach diffusion process. The experimental results are in much better accord with the theory advanced by I.M.Lifshits and G.D.Parkhomovskii (Abstr. 1669/1951; Uchenÿe Zapiski Kharkovskogo Gos. Univ., Vol. 27, 25, 1948) than with that of Mason and McSkimin (Abstr. 2444/1947). A.Gelbtuch

534.232

8059. EXCITATION OF A QUARTZ RADIATOR AT SEVERAL FREQUENCIES SIMULTANEOUSLY. G.D.Mikhailov, N.V.Tikhonova and I.M.Yadrova.
Akust. Zh., Vol. 2, No. 2, 231, (April-June, 1956). In Russian.

Such radiators could be used in research on the interaction of ultrasonic waves, in dispersion measurements etc. in both liquids and gases. The authors took a quartz plate of 10 mm radius and 3 mm thickness. One circular face had an electrode all over it to serve as a common zero pole for two generators. The other face had two equal almost semi-circular electrodes, each covering practically half the area with 1 mm interpolar space. The plate was placed in water and one pair of electrodes excited with consequent setting up of a system of standing waves. Exciting the second pair of electrodes gave a second set of waves but the intensity of the first set was somewhat reduced. C.R.S.Manders

534.24

8060. USE OF LAYERS PREVENTING THE FORMATION OF TRANSVERSE WAVES DURING REFLECTION OF A LONGITUDINAL WAVE AT THE BOUNDARY OF A SOLID BODY. M.A.Isakovich.
Akust. Zh., Vol. 2, No. 2, 150-3 (April-June, 1956). In Russian.

Results are quoted for acoustic experiments with a Cd layer on steel. Curves are given for the amplitude of transverse waves against thickness of the layer which show that for 1 Mc/s incident longitudinal waves a 1.3 mm (i.e. 0.45 of the acoustic wavelength) layer of Cd causes reduction of the transverse wave amplitude to zero. The bandwidth of incident longitudinal waves inside which the amplitude of transverse waves does not exceed 0.1 of incident wave amplitude varies from about 6.5 to 10%. The use of several layers of various materials deposited successively, causes notable broadening of the band. The problem is also treated theoretically and it

is pointed out that a similar treatment can be employed in the case of incident transverse waves setting up longitudinal waves. C.R.S.Manders

534.24

8061. NON-SPECULAR REFLECTION OF SOUND BY A THIN CYLINDRICAL SHELL. L.M.Lyamshev.
Akust. Zh., Vol. 2, No. 2, 188-93 (April-June, 1956). In Russian.

A quartz vibrator produced 30 μsec pulses of 1 Mc/s waves with a rectangular envelope and repetition frequency of 50 per sec. It served both as a transmitter and a receiver. It is shown that non-specular reflection of sound from a thin shell is caused by oscillations of the shell excited by the incident sound waves. The direction for which this non-specular reflection occurs is determined by the relation between the velocity of propagation of the oscillation in the shell and the velocity of sound in the surrounding liquid. C.R.S.Manders

534.24

8062. REFLECTION OF SOUND BY THICK FINITE PLATES IN A LIQUID. L.M.Lyamshev and S.N.Rudakov.
Akust. Zh., Vol. 2, No. 2, 228-30 (April-June, 1956). In Russian.

Thick plates of steel, brass and aluminium were used whose thickness was comparable with, or greater than, the wavelength in them of the longitudinal waves used. They were suspended in water. A quartz pulse generator (f = 1 Mc/s, pulse repetition frequency = 200 per sec, 1 μsec pulses) also acted as receiver. Rotating the plates about a vertical axis enabled reflection polar diagrams (three are given) to be plotted. The number of non-specular reflections found increases with increase of thickness of the plate and with increase of frequency. C.R.S.Manders

534.24

8063. NON-SPECULAR REFLECTION OF SOUND FROM THIN, BOUNDED PLATES SUBMERGED IN A LIQUID. L.M.Lyamshev.
Acta phys. Hungar., Vol. 6, No. 1, 33-65 (1956).

The present paper describes the theory and the results of an experimental investigation of non-specular reflection of sound, including a new type of non-specular reflection due to the transverse vibrations caused by the pressure exerted on the plates. It is shown that in the plates a spatial frequency resonance phenomenon takes place, giving rise to the fine structure of non-specular reflection. The experimental investigations carried out at 1 Mc/s by means of a laboratory equipment providing the necessary accuracy of the measurement show that the theory describes the phenomenon in good agreement with experiment. A.

534.26 : 534.21

8064. THE SCATTERING AND RADIATION OF WAVES BY STATISTICALLY NON-UNIFORM AND STATISTICALLY OSCILLATORY SURFACES. M.A.Isakovich.
Akust. Zh., Vol. 2, No. 2, 146-9 (April-June, 1956). In Russian.

The Kirchhoff principle is applied to the scattering of waves at a plane surface having a statistically distributed reflection coefficient and to the radiation from a statistically oscillating surface. C.R.S.Manders

534.26

8065. DIFFRACTION BY A CYLINDER OF FINITE LENGTH. W.E.Williams.
Proc. Cambridge Phil. Soc., Vol. 52, Pt 2, 322-35 (1956).

The diffraction of a plane harmonic sound wave by a hollow circular cylinder of finite length is considered. The problem is treated by using Laplace transforms and is reduced to the solution of two complex integral equations. An approximate solution is obtained for these equations when the product of the wave number (k) and the cylinder length (l) is large. The resonance of the system is considered and an equation derived for the resonant lengths which is then solved approximately for kl large. An explicit expression is obtained for the end correction of an r-resonant system (i.e. $kl \approx r\pi$), and also comparison is made with experimental results. A.

534.26

8066. SCATTERING OF SOUND WAVES BY A DROP OF LIQUID. M.Moshinsky.
Rev. Mexicana Fís., Vol. 4, No. 2, 95-108 (April, 1955). In Spanish.

Deals with the scattering of sound waves in a gas, by liquid drops or soap bubbles. The main interest of this analysis lies in the insight it gives on the problem of scattering of nucleons by collective motions according to the model of Aage Bohr. The equations and boundary conditions that characterize the scattering, both for the case of a liquid drop and for the case of a soap bubble are discussed. The case of the soap bubble would be nearer to the nuclear case, because of the natural frequencies of vibration of the air inside the soap bubble and of the soap bubble itself. The effect of the soap bubble on the position of the resonances and their widths, (defined in a way similar to the nuclear scattering problem) is discussed in detail. A.

534.26

8067. THE SCATTERING OF SOUND WAVES ON SINUSOIDAL AND SERRATED SURFACES. A.N.Leporskiĭ.
Akust. Zh., Vol. 2, No. 2, 177-81 (April-June, 1956). In Russian.

An experimental equipment and method of measurement were described in a previous paper (Abstr. 4937/1956). In the present paper the author compares results obtained with those expected from a theory due to Lysanov (Dissertation, Moscow University, 1955). Agreement appears satisfactory. C.R.S.Manders

534.26

8068. AN APPROXIMATE SOLUTION OF THE PROBLEM OF THE SCATTERING OF SOUND WAVES ON AN UNEVEN SURFACE. Yu.P.Lÿsanov.
Akust. Zh., Vol. 2, No. 2, 182-7 (April-June, 1956). In Russian.

A method is suggested for calculating the scattering of sound waves upon an uneven surface. The method is based on the solution of an approximate integral equation for the normal component of fluctuation velocity at the scattering surface. C.R.S.Manders

534.321.9

8069. BIOLOGICAL ACTION OF ULTRASONIC WAVES. I.E.Él'piner.
Akust. Zh., Vol. 2, No. 2, 217-22 (April-June, 1956). In Russian.

The passage of ultrasonic waves through biological material brings about physical effects associated with processes of propagation of elastic mechanical oscillations in a liquid medium. Thus alternating pressure effects, effects of acceleration and displacement of particles, cavitation effects, etc. occur and they may cause breakdown of the living cell. The author's work with yeast cells (photographs) supports the view that ultrasonic waves are able to loosen or break the bonds of molecular complexes of the submicroscopic structures of cell elements. C.R.S.Manders

534.321.9

8070. DETECTION OF FAULTS IN TYRES TESTED BY AN ULTRASONIC TRANSMISSION METHOD. P.Rieckmann.
Z. angew. Phys., Vol. 8, No. 8, 386-91 (Aug., 1956). In German.

Experiments are described showing than an ultrasonic (200 kc/s) method is capable of detecting even minor faults in tyres. It is necessary to use a narrow parallel beam of light, the diameter of which is small in comparison with the ultra-

sonic wavelength, for making visible the interference patterns and to make observations in a reflection-free trough. A suitable detector microphone employing barium titanate is described. The sensitivity of the method is affected if the tyre has a marked tread pattern. H.J.H.Starks

534.413

8071. (SOUND-)SENSITIVE GAS AND LIQUID JETS. M.Dubois.
Ann. Télécomm., Vol. 11, No. 5, 111-16 (May, 1956). In French.

Sound-induced disturbances (turbulence, change of shape, etc.) in laminar and slightly turbulent free jets have been stroboscopically investigated. Tabulated and plotted results show sound frequency ranges found to affect air jets emerging from 0.9-2.38 mm dia. tubes at velocities from 2500 to 320 cm/sec, and water jets emerging from 0.74-2 mm dia. tubes at velocities of 250 down to 31 cm/sec. A.Gelbtuch

534.61

8072. ABSOLUTE METHOD FOR SOUND INTENSITY MEASUREMENT. D.R.Pardue and A.L.Hedrich.
Rev. sci. Instrum., Vol. 27, No. 8, 631-2 (Aug., 1956).

Since sound propagation is an adiabatic process, a temperature fluctuation accompanies the sound wave in media for which the specific heat ratio is greater than unity. If the equation of state and the sound field are known, this temperature fluctuation may be related to the intensity of the sound wave. A thermometer capable of measuring fast, small-amplitude temperature variations is described. Its output is calculated for the case of plane, sinusoidal sound waves in an ideal gas. Its use as a microphone and sound intensity meter is then considered. A.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85.

534.78

8073. SOME RESULTS OF AN ANALYSIS OF THE SINGING VOICE. S.N.Rzhevkin.
Akust. Zh., Vol. 2, No. 2, 205-10 (April-June, 1956). In Russian.

"Singing formants" are found in the voice of a highly trained singer at about 500 and 2500 c/s, identical on all vowels and over the whole range from low to high notes. In the inexperienced singer these formants are not clearly expressed or stable. A hypothesis is put forward regarding the rapid build-up of the voice of a trained singer from the speech position at the beginning of a vowel sound to that of the singing position. C.R.S.Manders

OPTICS. RADIATION. SPECTRA 535

535.23.08 : 535.33.07

8074. SOME CONSIDERATIONS OF THE BALANCED SPECTRORADIOMETRY. H.Mitsuhashi.
Sci. of Light (Tokyo), Vol. 4, No. 1, 61-71 (Aug., 1955).

While the spectral absorption and reflectance of any sample can be measured with a double beam spectrophotometer with considerable accuracy, no exact method of spectroradiometric measurement of emission spectra with phototubes has as yet been established. Accurate spectroradiometric measurements independent of various characteristics inherent to phototubes, amplifiers, etc., can be effected by setting up a reference light beam which is neutral within the wavelength range to be investigated. The possibility of such balanced spectroradiometer to be used in the visible region is here discussed and a few examples are presented together with some data of preliminary experiments. A.

535.247.4 : 551.521.326

RECORDING NIGHT SKY PHOTOMETER OF HIGH SPECTRAL PURITY. See Abstr. 7894

535.312.5

8075. MEASUREMENTS OF NOISE AND RESPONSE TO MODULATED LIGHT OF CADMIUM SULPHIDE SINGLE CRYSTALS. K.M.Van Vliet, J.Blok, C.Ris and J.Steketee.
Physica, Vol. 22, No. 8, 723-40 (Aug., 1956).

The noise of photoconducting single crystals of silver-activated and undoped cadmium sulphide has been investigated in the range 1 c/s-2 Mc/s. The observed spectra are not of the 1/v type but show several characteristic features, which depend on the experimental conditions, including the light intensity, the wavelength of the light and the temperature. In particular, entirely different spectra have been obtained with irradiation in the fundamental absorption band for light of wavelengths beyond the absorption limit (5100 A). Measurements of the response of the crystals to modulated light for modulation frequencies in the range 7 c/s-10 kc/s led to response curves, which showed much resemblance with the noise spectra under all circumstances. So a large part of the noise must be considered as photo-induced noise. The other part is ascribed to spontaneous fluctuations in the rates of recombination and trapping. A.

535.312.5

8076. INVESTIGATION ON THE USE OF A LIQUID SURFACE MIRROR FOR A FLAT PLANE OF REFERENCE. R.Bünnagel.
Z. angew. Phys., Vol. 8, No. 7, 342-50 (1956). In German.

Experiments are reported using paraffin, silicone oil and castor oil on mercury. Distortions produced on the liquid surface both by static charging and by temperature variations are studied. With a disc of 24 cm diameter at 4 cm from the edge the radius of curvature is 2×10^4 km. The influence of earth curvature is not established. The observed curvature is the same for the three liquids studied. Static charges can persist for several days and are formed even by the pouring of the oil on the mercury. To avoid this the oil used should have a conductivity of at least 10^{-11} ohm^{-1} cm^{-1}. With castor oil, a temperature difference of 0.01°C at the ends of a 11 cm disk does not produce a detectable effect. S.Tolansky

535.317.1 : 621.397.5

8077. SUBJECTIVE SHARPNESS OF SIMULATED COLOR TELEVISION PICTURES. M.W.Baldwin, Jr and G.Nielsen, Jr.
J. Opt. Soc. Amer., Vol. 46, No. 9, 681-5 (Sept., 1956).

Describes a visual experiment in which the observed variable is the subjective sharpness of a colour picture. This picture is produced by the superposition of primary colour images from three projectors. The test picture corresponds, in general sharpness, to the grades of pictures that might be produced by existing or contemplated colour television systems. The projectors are operated out of focus to achieve the moderate sharpness values required. The amount of defocus of each projector is expressed in equivalent television bandwidth as part of the calibration. Many different ways of dividing up bandwidth among the three primary colours are explored in determining the variation of picture sharpness. A.

535.317.1

8078. APPLICATION OF APPROXIMATION THEORIES TO THE STUDY OF OPTICAL IMAGES. J.Arsac.
Optica Acta, Vol. 3, No. 2, 55-65 (June, 1956). In French.

An optical instrument can be considered as a filter of spacial frequencies which only transmits frequencies below a certain limit. The result is that the image, generally different from the object, can only be an approximation to it. An extension of Bernstein's theorem make it possible to give the limits of the derivatives in the image as a function of the frequency of cut-off and of the maximum illumination in the image. An optical instrument operates for the object as a "process of summa

tion" in the mathematical sense of the term. The two characteristics of these processes: power (ability to reproduce more or less regular objects) saturation (inability of the distinctness between object and image to go below a certain value) appear as useful criteria for the assessment. A.

535.317.1

8079. THE DEFOCUSED IMAGE OF SINUSOIDAL GRATINGS. W.H.Steel.
Optica Acta, Vol. 3, No. 2, 65-74 (June, 1956).

The defocused image of an infinite sinusoidal grating is calculated by scalar diffraction theory for a perfect optical system. It is shown that the image contrast for both circular and annular pupils and for either incoherent or partially coherent illumination can be found in terms of incomplete Bessel and Struve functions. The results of some typical cases are given. The effect of limiting a grating to a finite number of periods is considered. The results are applied to a consideration of resolving power tests. A.

535.317.6

8080. POTENTIALITIES, FOR IMAGE EVALUATION, OF GEOMETRIC RAY TRACE FOCAL PLOTS. R.J.LaBauve and R.A.Clark.
J. Opt. Soc. Amer., Vol. 46, No. 9, 677-80 (Sept., 1956).

The formulae of R.E.Hopkins giving resolving power as a function of certain image "energy" diameters have been applied to geometric focal plots of an f/4.7, 36 in. focal length parabolic reflector and the Hopkins designed Elgeet Navitar lens for the CZR-1 Bowen camera. The formula $R = 605(d_e^2 + d_f^2)^{-1/2}$ gives the resolution R in lines/mm; d_e represents the diameter of the circle containing 30% of the energy in the image, and d_f is a constant of the emulsion, both expressed in microns. The parameter d_e was obtained by direct measurements on focal plots of the geometric ray traces, and the resulting resolving powers were compared with corresponding measured values. The comparison, so far, has been confined to Super XX and reveals the limited nature and over-all conservatism of the method. A.

535.323

8081. MEASUREMENT OF THE REFRACTIVE INDICES OF THIN LAYERS OF ZINC SULPHIDE AND CRYOLITE. I.N.Shklyarevskiĭ and A.N.Ryazanov.
Zh. tekh. Fiz., Vol. 26, No. 3, 659-63 (1956). In Russian.

Contrary to the findings of Schulz and Scheibner (Abstr. 1762/1951), the authors have found that the refractive index of thin ZnS films (as used in multi-layer coatings) is equal to that of ZnS in bulk, whereas the refractive index of cryolite films depends on their thickness. The "filling" factor of (porous) cryolite films, whose pores have been filled with a liquid, calculated from the equation $n^2 = q_1 n_1^2 + q_2 n_2^2$ [where n, n_1 and n_2 are the refractive indices of the total film, its cryolite substance and the substance in its pores respectively, while q_1 and q_2 are the fractional volumes of the cryolite and the pores ($q_1 + q_2 = 1$)], has been found to closely agree with experiment; this finding proves, in turn, that the liquids used (glycerol, paraffin oil, nitrobenzene, iodomethylene) fill thoroughly the pores in ZnS. F.Lachman

535.329

8082. ANOMALOUS DISPERSION OF LIGHT IN VERY SIMPLE SOLUTIONS OF INORGANIC COMPOUNDS. I.S.Gorban' and A.A.Shishlovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 108, No. 1, 53-5 (1956). In Russian.

The dispersion curve in the F-centre band in sodium chloride irradiated with X-rays is fitted much better (almost quantitatively) by a curve worked out from Davidov's theory of dispersion of light in dilute solutions (Abstr. 7313/1954) than by a curve worked out from the usual oscillatory functions. R.C.Murray

535.33.03

8083. PART PLAYED BY THE EXTERNAL MEDIUM IN THE EXCITATION OF ATOMIC SPECTRA IN THE ARC DISCHARGE. K.N.Mochalov and E.L.Raff.
Zh. tekh. Fiz., Vol. 26, No. 3, 505-10 (1956). In Russian.

Atomic spectra of Al, Be, V, Fe, Ca, Co, Si, Li, Mg, Ni, Ti, Cr and Zn were found to be weaker when the arc was maintained in a He atmosphere than in A or air, whereas the reverse obtained for the ionic spectra. On the other hand, Fe spectrum, when obtained in I vapour, had stronger atomic lines and weaker ionic lines than in air. These findings prove once more that the part played by the medium may affect the evaporation of the electrode substance. F.Lachman

535.33.07

8084. SPECTRAL PURITY. G.K.T.Conn.
Amer. J. Phys., Vol. 24, No. 6, 451-4 (Sept., 1956).

Simple expressions are derived for the spectral purity of spectrometers of any slit width in terms of a variable α which expresses the angular slit width in terms of the diffraction pattern of the horizontal aperture. The range in wavelength embraced in the exit focal plane, $\Delta\lambda = \lambda(\alpha + h(\alpha))/R$, where $h(\alpha)$ the correction for diffraction and R the Rayleigh resolving power. In terms of wavenumber this corresponds to $\Delta\nu = (\alpha + h(\alpha))/(\lambda R)$. These expressions are valid both for prisms and gratings. The form of $\Delta\nu$ suggests that prismatic materials should be assessed according to a dispersive number $dn/d\log\lambda$ rather than the dispersion $dn/d\lambda$. A.

535.33.07

8085. AN APPARATUS FOR THE SPECTROSCOPIC OBSERVATION OF VARIOUS STAGES OF SPARK DISCHARGES. H.Israël and G.Fries.
Optik, Vol. 13, No. 8, 365-8 (1956). In German.

Describes an optical technique for observation of time resolved spectra of transient discharges. J.D.Craggs

535.33.07 : 535.24

8086. HETEROCHROMATIC PHOTOMETRY OF CONTINUOUS SPECTRA: CONTRIBUTION TOWARDS THE PROVISION OF A NEUTRAL STANDARDIZING METHOD FOR PHOTOGRAPHIC PLATES. G.Balasse and M.L.Lemmens.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 41, No. 9, 944-73 (1955). In French.

In the spectrophotometric calibration of photographic material it is essential that any method of reducing the intensity of the luminous source to a predetermined value shall yield the same reduction ratio at all wavelengths. An "extra-defocalization" method of using rotating wire-mesh screens to achieve a high degree of neutrality over the spectral range, 3500-7500 A, is described, and compared with existing conventional devices, e.g. rotating sectors. By its use, the effects of intermittency are entirely eliminated. D.R.Barber

535.33.07

8087. A LIGHT-MODULATOR FOR USE WITH AN INFRARED DETECTOR. R.Kessler.
Z. angew. Phys., Vol. 8, No. 8, 405-6 (1956). In German.

The infrared beam is modulated to give a pure sine wave by a vibrator which also modulates an auxiliary light beam to a photocell, the output of which is used to drive the vibrator. The arrangement has been in use on a spectrometer for 2 years. G.F.Lothian

535.331

8088. NEW DESCRIPTIONS AND ANALYSES OF THE THIRD AND FOURTH SPECTRA OF ZIRCONIUM, Zr III AND Zr IV. C.C.Kiess.
J. Res. Nat. Bur. Stand., Vol. 56, No. 4, 167-77 (April, 1956).

Recent observations of the spectra emitted by ionized zirconium atoms have added many new lines to the descriptions of these spectra and have led to revisions and extensions of their term structures. The low, even terms of Zr III arise in the electron configurations $4d^2$, 4d 5s, and $5s^2$. Excitation

of these states leads to higher terms of the 4d 5p, 5s 5p, 4d 5d, 4d 6s, 4d 4f, 5s 5d, 4d 6p, 5s 6s, 5s 4f, and 5s 5g configurations. Most of the singlet and triplet terms from these configurations have now been established. Zeeman patterns from Massachusetts Institute of Technology plates have confirmed and corrected some of the classifications of earlier work. From the series-forming terms of Zr III the separation of the ground states of Zr III and Zr IV is calculated as 198 590 cm^{-1}, corresponding to an ionization potential of 24.6 eV for the ion Zr^{2+}. In the doublet spectrum of Zr IV, which arises from the migration of the single electron outside the krypton shell, the terms from the 7s, 6p, 6d, 5f, 6f, 5g and 6g electrons have been added to those already known. A mean value of 276 970 cm^{-1} for the separation of the ground states of Zr IV and Zr V has been derived from three accordant values calculated from series of ^2S, $^2F^0$ and ^2G terms. This corresponds to an ionization potential of 34.33 eV for Zr^{3+}. A.

535.333

8089. BLUE EMISSION FROM THE VAPOR OF BURNING BORON. R.F.Porter and D.A.Dows.
J. chem. Phys., Vol. 24, No. 6, 1270-1 (June, 1956).

Two groups of bands were observed, one in the region λ 4250-λ 4500, the other in λ 4750-λ 5100. A microphotometer trace of the shorter wavelength region was made to gain information about the emitter species. It is suggested that gaseous B_2O_2, which is stable under reducing conditions, may be the emitter of the blue bands. A vibrational analysis shows at least two series, $\Delta\nu \sim 300$ cm^{-1} and ~ 2600 cm^{-1}. J.Jacobs

535.333

8090. BAND SPECTRA EMITTED BY STRONTIUM AND BARIUM IN ARCS AND FLAMES. M.Charton and A.G Gaydon.
Proc. Phys. Soc. A, Vol. 69, Pt 7, 520-6 (July, 1956).

Studies have been made of the spectra given by strontium and barium in an oxy-hydrogen flame, in a "vacuum arc" in water vapour, in a "vacuum arc" in heavy-water vapour (D_2O), and in an arc in air at atmospheric pressure. For strontium, a band with some structure at 6050 A and diffuse bands with maxima at 6460, 6590, 6675 and 6820 A are attributed to SrOH, in agreement with James and Sugden's suggestion, the assignment being supported by small isotopic displacements with SrOD. Bands at 5950, 6050 and the far red, obtained best in the arc at 1 atm., have a very complex structure suggesting a polyatomic emitter and variation of strength with concentration when strontium nitrate solution is sprayed into a flame supports assignment to the dimer of the oxide, Sr_2O_2. For barium, bands in the green and photographic infrared are attributed to BaOH, the assignment again being supported by the isotopic shift. Diffuse complex bands near 4800, 5020 and 5500 A in the arc in air may be due to the corresponding oxide dimer, Ba_2O_2. A.

535.333

8091. PERSISTANCE OF VIBRATION AND OF ROTATION IN THE EMISSION SPECTRUM OF THE MOLECULE C_2. J.Akriche.
Ann. Phys. (Paris), Sér. 13, Vol. 1, 611-22 (July-Aug., 1956). In French.

A study has been made of relative intensities of bands and of lines in the Swan system excited in a discharge tube. There appears to be no unique rotational or vibrational temperature. R.F.Barrow

535.337 : 548.7

ZEEMAN EFFECT IN THE YELLOW EXCITON SERIES OF CUPROUS OXIDE CRYSTALS. See Abstr. 7819

535.338.32

8092. THE INTENSITY RATIO OF THE SODIUM D LINES IN FLUORESCENCE EMISSION. R.Seiwert.
Ann. Phys. (Leipzig), Vol. 18, No. 1-2, 35-53 (1956). In German.

The density distribution of sodium atoms in the two excited $3\,^2P$ states due to resonance excitation of the vapour by irradiation in one of the two D lines is investigated and various values for the collision probabilities of the atoms obtained. Equilibrium equations are set up for the collisions and radiative transitions involved and a relation between the ratio of D line fluorescence intensities and the collision probabilities provided. G.F.J.Garlick

535.338.32

8093. COLLISIONS WITH SODIUM ATOMS IN ONE OF THE TWO $3\,^2P$ STATES. R.Seiwert.
Ann. Phys. (Leipzig), Vol. 18, No. 1-2, 54-79 (1956). In German.

The D line fluorescence intensity ratio of resonance excitation of sodium vapour, of sodium vapour–air mixtures and of sodium and potassium vapour mixtures is investigated and shown to depend on the diffusion of radiation and hence on the geometry of the resonance tube etc. Contradictions between results of different previous workers are thereby explained. Values of collision cross-sections are calculated. See also preceding abstract. G.F.J.Garlick

535.342

8094. KINETIC INTERPRETATION OF THE TEMPERATURE DEPENDENCE OF INFRARED ABSORPTION. T.L.Brown.
J. chem. Phys., Vol. 24, No. 6, 1281-2 (June, 1956).

From recent recorded data (Abstr. 6013/1955; 3622/1956) on the infrared spectra of substances in solution, it appears that collisional processes are chiefly responsible for the change in band shape with temperature. G.I.W.Llewelyn

535.343 : 539.132

ON THE λ 1600-1350 ABSORPTION SYSTEM OF NITROGEN DIOXIDE AND ITS ELECTRONIC STRUCTURE. See Abstr. 7588

535.343

8095. ABSORPTION SPECTRA OF ETHYLENE AND ETHYLENE-d_4 IN THE VACUUM ULTRAVIOLET. II. P.G.Wilkinson.
Canad. J. Phys., Vol. 34, No. 7, 643-52 (July, 1956).

For previous part see Abstr. 3615 (1956). These spectra have been investigated in the 1300 A to 1500 A region using the first order of a 21 ft vacuum grating spectrograph. Vibrational constants for the $\nu_2(a_g)$ stretching vibration and the $\nu_4(a_u)$ twisting vibration have been determined for each of the observed five Rydberg states. The torsional oscillator–rotator treatment has been applied to the observed twisting data, and potential barriers hindering free rotation of 500 to 1200 cm^{-1} were obtained. It is concluded that the stable equilibrium configuration of the Rydberg states is not of D_{2h} symmetry but is probably bent or staggered. A.

535.343

8096. ULTRAVIOLET ABSORPTION SPECTRA OF α-METHYL NAPHTHALENE AND β-METHYL NAPHTHALENE IN THE LIQUID AND SOLID STATES. S.B.Banerjee.
Indian J. Phys., Vol. 30, No. 3, 106-16 (March, 1956).

These were studied at low temperatures and the results compared with those for the vapour state reported by previous authors. Both the substances yield two systems of bands. In the case of α-methyl naphthalene, in the first system of bands the 0-0 band is at 31 192 cm^{-1} for the liquid state and is displaced by 976 cm^{-1} towards the longer wavelength side from its position in the vapour state. The 0-0 band in the solid state is at 31 285 cm^{-1} and shows only a small displacement of 93 cm^{-1} with respect to that in the liquid state. Thus the major change in the 0-0 band of this system takes place with the liquefaction of the vapour. In the second system, on the other hand, the major change in the excited electronic state occurs when the liquid is solidified and cooled to −180° C. It was found necessary to assume that the electronic energy level is split

p due to strong intermolecular field resulting from the formation of virtual bonds between neighbouring molecules in the solid state at –180°C in order to assign the bands satisfactorily. In the case of β-methyl naphthalene, in the first system the 0-0 bands for the liquid and solid states are at 31 202 and 31 114 cm^{-1} respectively, while that for the vapour state is at 31 593 cm^{-1}. Thus with the liquefaction of the vapour and the subsequent solidification of the liquid the 0-0 band shifts towards longer wavelengths by 391 and 479 cm^{-1} respectively. The 0-0 band of the second system due to the liquid undergoes a large shift of 1584 cm^{-1} towards longer wavelengths from its position in the case of the vapour. With solidification of the liquid there is a further shift of 234 cm^{-1} of the 0-0 band towards longer wavelengths. But in this case no splitting of energy level is observed with solidification and lowering of temperature. The results are compared with those obtained by previous authors for the frozen solution of β-methyl naphthalene in 3-methyl pentane rigid glass solvent at 77°K. A.

535.343

8097. ANALYSIS OF THE NEAR ULTRAVIOLET ABSORPTION SPECTRUM OF ORTHOCHLOROANISOLE. S.Suryanarayana and V.Ramakrishna Rao.
Indian J. Phys., Vol. 30, No. 3, 117-28 (March, 1956).

About 66 bands were recorded in the absorption spectrum of orthochloro-anisole in the region 2873 to 2503 A and interpreted on the basis of 8 fundamentals in upper state and 4 fundamentals in lower state. In the light of Raman frequencies and their depolarization factors, the ultraviolet fundamentals are correlated and assigned to various modes of vibration. The molecule is assumed to belong to the point group C_s. A.

535.343

8098. ULTRAVIOLET ABSORPTION SPECTRA OF FROZEN SOLUTIONS OF o-, m- AND p-CHLOROTOLUENE IN ISOBUTYL ALCOHOL. S.B.Roy.
Indian J. Phys., Vol. 30, No. 6, 276-84 (June, 1956).

The ultraviolet absorption spectra of solutions of o-, m- and p-chlorotoluene in isobutyl alcohol in the liquid and solid states at –180°C have been investigated. The results obtained have been compared with those reported by previous workers for the pure liquid and for solid state at –180°C. It has been observed that in case of the solutions in the solid state no splitting of electronic energy level of either -chlorotoluene or m-chlorotoluene molecule takes place although in the case of the pure substances in the solid state splitting of the band was observed by previous workers. In the case of o-chlorotoluene, the position of the 0,0 band due to the pure liquid, solution in isobutyl alcohol and the solution frozen and cooled to –180°C is almost the same but it shifts much when the pure substance is frozen and cooled to –180°C. Probably the presence of permanent electric moment in the molecules of the ortho- and the meta-compound facilitates formation of virtual bonds between neighbouring molecules in the solid phase of the pure substances. Formation of such bonds may be responsible for splitting of the energy level. A.

535.343

8099. APPEARANCE OF TWO INTRAMOLECULAR CHARGE TRANSFER ABSORPTIONS OBSERVED WITH SOME DISUBSTITUTED BENZENES. J.Tanaka and S.Nagakura.
J. chem. Phys., Vol. 24, No. 6, 1274-5 (June, 1956).

The clear distinction between the recorded u.v. absorption spectra of p-disubstituted benzenes and of o-, m-disubstituted benzenes may be interpreted on the theory of intramolecular charge transfer absorption proposed by the authors (Abstr. 1976/1956). G.I.W.Llewelyn

535.343

8100. FLUCTUATING[VIBRATIONAL]STRUCTURE IN THE ABSORPTION SPECTRUM OF RUBY. B.N.Grechushnikov and P.P.Feofilov.
Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 384 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 330 (March, 1956).

The absorption band for ruby (alumina containing 0.1% of Cr_2O_3) with a maximum at about 560 mμ has a fine structure on the long wave side, with peaks at 16 780, 16 900, 17 200, 17 410 and 17 640 cm^{-1}. The distances between the adjacent maxima average 215 cm^{-1}. The origin of the fine structure is considered to be the interaction between the optical electrons at the "absorption centre" and the lattice vibrations. R.C.Murray

535.343

8101. FUNDAMENTAL ABSORPTION BANDS OF H_2Te. K.Rossmann and J.W.Straley.
J. chem. Phys., Vol. 24, No. 6, 1276-7 (June, 1956).

The observed infrared absorption spectrum of H_2Te is graphically represented. Assuming the molecule to be an accidentally symmetric top, the molecular constants are deduced. G.I.W.Llewelyn

535.343 : 548.736.6

8102. THE INFRA-RED SPECTRUM OF AFWILLITE, $Ca_3(SiO_3OH)_2.2H_2O$, IN RELATION TO THE PROPOSED HYDROGEN POSITIONS. H.E.Petch, N.Sheppard and H.D.Megaw.
Acta cryst., Vol. 9, Pt 1, 29-34 (Jan., 1956).

The infrared absorption spectrum of afwillite, $Ca_3(SiO_3OH)_2.2H_2O$, has been examined in the region 2000-3500 cm^{-1} in powdered material and in thin sections of a single crystal cut parallel to (100), (010) and (10$\bar{1}$). Using unpolarized radiation and powdered afwillite, two very broad bands were observed centred at about 2400 and 2800 cm^{-1} and two less broad bands close to 3130 and 3340 cm^{-1}. The polarization properties of the bands at 3130 and 3340 cm^{-1} were studied using the thin sections. These bands appear only when the electric vector has a component perpendicular to the crystallographic y axis, and it is found that the band at 3340 cm^{-1} actually consists of two overlapping bands with a frequency difference of approximately 60 cm^{-1}. These results confirm that both long and short hydrogen bonds are present in the afwillite structure. There is a fair correlation between the polarization directions of the absorption bands and those predicted from the X-ray structure analysis for the OH and H_2O groups. A.

535.343 : 548.736.5

8103. THE INFRA-RED SPECTRUM AND CRYSTAL STRUCTURE OF GYPSUM. M.Hass and G.B.B.M.Sutherland.
Proc. Roy. Soc. A, Vol. 236, No. 1207, 427-45 (1956).

Infrared spectra of single crystals of gypsum ($CaSO_4.2H_2O$) have been obtained between 450 and 3800 cm^{-1} by measurement of transmission and reflection of plane-polarized radiation on three different crystal sections. Analysis of these observations, when combined with previous results on the Raman spectrum of gypsum, makes it possible to assign sixteen out of the eighteen internal fundamental modes of the two sulphate ions, and ten of the twelve internal fundamental modes of the four water molecules in the unit cell. Comparison of the spectra of the sulphate ions and water molecules in gypsum with those given by sulphate ions in solution and water molecules in the gaseous phase provides some information on the nature of the crystalline field. If the intensities and the dichroism of the water bands are used to verify the orientations of the water molecules in the crystal (as determined by nuclear magnetic resonance) the results obtained are anomalous. The agreement between prediction and observation is satisfactory for the deformation mode of vibration but quite satisfactory for the two stretching modes. Possible causes of this anomaly are discussed. A.

535.343

8104. THE INFRARED SPECTRUM OF ACETYLENE-d_1. H.C.Allen, Jr, E.D.Tidwell and E.K.Plyler.
J. Amer. Chem. Soc., Vol. 78, No. 13, 3034-40 (July 5, 1956).

The vibrational-rotational spectrum of acetylene-d_1 has been observed and measured from 1800 to 9200 cm^{-1}. Rotational structure sufficient to enable an analysis was found for 28 bands. From the average combination-difference values of the 14 best bands the rotational constants were found to be, $B_0 = 0.99169 \pm 0.000\,15\ cm^{-1}$ and $D_0 = 1.08 \pm 0.26 \times 10^{-6}\ cm^{-1}$. The vibrational energy system is fully discussed. It is pointed out that the vibrational energy levels cannot be fitted by the usual quadratic expansion of the energy in terms of the vibrational quantum numbers. Evidence is presented to show that at least cubic terms must be included in the expansion. A.

535.343

8105. VIBRATIONAL CONSTANTS OF ACETYLENE-d_2.
H.C.Allen, Jr, L.R.Blaine and E.K.Plyler.
J. Res. Nat. Bur. Stand., Vol. 56, No. 5, 279-83 (May, 1956).

The infrared spectrum of acetylene-d_2 has been investigated in the region from 1 to 5 microns. The new data have enabled a consistent interpretation of the 16 bands in which only the stretching modes are excited. It is shown that there is a resonance interaction present between the vibrational levels (v_1, v_2, v_3)and ($v_1 - 2$, v_2, $v_3 + 2$) analogous to that present in C_2H_2. The new vibrational constants enable the calculation of band centres that are in excellent agreement with the observed band centres. By combining the photographic infrared results with those obtained in this work it is found that $B_0 = 0.847\,70 \pm 0.000\,07\ cm^{-1}$ and $D = (7.04 \pm 0.63) \times 10^{-7}\ cm^{-1}$. A.

535.343

8106. RADIO-FREQUENCY SPECTRA OF Li^6Cl BY THE MOLECULAR BEAM ELECTRIC RESONANCE METHOD.
D.T.F.Marple and J.W.Trischka.
Phys. Rev., Vol. 103, No. 3, 597-611 (Aug. 1, 1956).

Transitions between the hyperfine structure levels of the rotational state of Li^6Cl with J = 1 were studied. The electric quadrupole interaction constant, $(e9Q)_{Cl}$, and the spin-rotation interaction constant, c_{Cl}, of the chlorine nucleus, and the product of the square of the molecular dipole moment, μ^2, and moment of inertia, A, were determined in several different vibrational states. These constants, and the ratios derived from them are listed, and the random errors in $\mu^2 A$ are given. The systematic error was $\pm 1.1 \times 10^{-76}$ c.g.s. The vibrational constant, ω_e, was found to be $536 \pm 60\ cm^{-1}$ from a study of line intensities. The magnetic field at the chlorine nucleus, H_R, was calculated to be 4.96 ± 0.23 gauss from c_{Cl} for Li^6Cl^{35} in the zeroth vibrational state. μ, and the internuclear distance, r, were found from beam deflection data to be 5.9 ± 1.3 Debye units 2.4 ± 0.4 A, respectively. A static electric field was used to study the Stark effect. When the static field was weak or absent, line frequencies were found to depend on the magnitude of the radio-frequency field used to produce transitions. This effect is termed "radio-frequency Stark effect". A theory for this effect was developed and accounts for the observations. A.

535.343

8107. MILLIMETER WAVE SPECTRUM OF FORMIC ACID.
G.Erlandsson.
J. chem. Phys., Vol. 25, No. 2, 379 (Aug., 1956).

535.343 : 539.132

MICROWAVE SPECTRA, DIPOLE MOMENT AND BARRIER TO INTERNAL ROTATION OF CH_3NO_2 AND CD_3NO_2. See Abstr. 7577

535.343 : 539.132

SOME VIBRATION-ROTATION BANDS OF DIAZOMETHANE. See Abstr. 7578

535.361.1 : 541.182.2

8108. THE TRANSMISSION OF LIGHT BY STABLE FOAMS.
S.Ross and M.J.Cutillas.
J. phys. Chem., Vol. 59, No. 9, 863-6 (Sept., 1955).

The transmission of light by stable foams is measured throughout the transition of the foam from a collection of spherical bubbles separated by relatively thick layers of liquid (kugelschaum) to a system of polyhedral bubbles separated by thin, plane films (polyederschaum). It is found that the light transmitted by the former type of foam increases relatively rapidly with time in a way that is described by a linear I^2 v. time plot. The latter type of foam appears only after most of the liquid has drained out of the films. Diffusion of gas, contained in smaller bubbles at higher pressures, into larger bubbles, at lower pressures, causes a spontaneous decrease of the specific interfacial area of the foam. A relatively slow increase in the intensity of transmitted light occurs during this process, and is described by a linear $\log(I_0/I - 1)$ v. t plot. Since the function $(I_0/I - 1)$ is proportional to the specific interfacial area, these results confirm previous statements in the literature that the rate of decrease of interfacial area of stable foams is logarithmic. The technique described separates the effects of drainage of liquid in a foam, during which there is no change in the sizes of bubbles, from that of gas diffusion, which causes a decrease of interfacial surface area. Preliminary tests with low concentrations of two antifoaming agents show that they accelerate the former process and do not affect the latter process. A.

535.361.2

8109. INVESTIGATION OF DIFFUSE REFLECTION BY MEANS OF POLARIZED LIGHT. I. A.P.Ivanov and A.S.Toporets.
Zh. tekh. Fiz., Vol. 26, No. 3, 623-30 (1956). In Russian.

In continuation of a previous investigation (Abstr. 7137/1950) the authors try to check the correctness of the assumption that the polarized-light component reflected by the outer surface of a light-diffusing layer preserves the polarization of the main beam, whereas the component reflected by the inner surface undergoes depolarization. A method of determining experimentally these two components is outlined and the sources of error are discussed. The depolarization of the "outer" component having been found negligible, an expression is derived for the effect of the degree of polarization of the "inner" component. Experiments conducted with translucent ("milky") glass, polished and matt, and with filter paper showed that: (1) the experimentally determined relationship between the degree of polarization of the inner component and the angle of observation agrees well with theory up to an angle of 50° (and beyond this angle for polished glass); (2) the degree of polarization of polarized light, after passing through a dispersing layer, depends largely on its thickness; (3) full depolarization occurs at a certain thickness, which is characteristic of the specimen tested; (4) the degree of polarization slightly increases as the angle of observation increases; (5) the magnitude of the polarized component of the reflected light is independent of wavelength when the angles of incidence and reflection are each = 45°, whereas there is a characteristic dependence when these angles are unequal (25° and 65°, respectively), which points to a certain polarization in the reflected light. F.Lachman

535.361.2

8110. INVESTIGATION OF DIFFUSE REFLECTION BY MEANS OF POLARIZED LIGHT. II. A.P.Ivanov and A.S.Toporets.
Zh. tekh. Fiz., Vol. 26, No. 3, 631-5 (1956). In Russian.

Presents the results of applying the method described in the preceding abstract to an investigation into the surface nature and scatter indices of objects capable of diffuse reflection. The relative distribution function of a rough surface can be determined by measuring photometrically the outer component of reflected light. The form of the scatter index (for paper, colourless and coloured powder) depends on the angle of incidence; its distortion is mainly due to the outer component; the inner component depends but little on the angle of incidence, and much more on the nature of the layer and its surface. F.Lachman

535.37 : 537.32

8111. OPTICAL AND ELECTRICAL PROPERTIES OF SOME OXYGEN ACTIVATED ALKALI HALIDES. J.Ewles and J.S.Barmby.
Proc. Phys. Soc, B, Vol. 69, Pt 6, 670-8 (June, 1956).

Phosphors showing well-resolved bands in their emission spectra have been made by thermal treatment of alkali halides in the presence of oxygen. The emission spectra are strikingly similar with quite different halides all showing a wave number difference of about 1000 cm^{-1} between the peaks of the main components of the band system. The chlorides and bromides show abnormal thermoelectric effects. It is suggested that both the similarity in the emission spectra and the abnormal thermoelectric effects can be accounted for by the adsorption of O_2^+ on active sites. A.

535.37

8112. TEMPERATURE DEPENDENCE OF THE RELAXATION TIME OF LUMINESCENCE OF PLATINO-CYANIDES OF BARIUM AND OF POTASSIUM, AND OF FLUORITE ACTIVATED WITH EUROPIUM. N.A.Tolstoĭ, A.M.Tkachuk and I.N.Tkachuk.
Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 386-7 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 331-2 (March, 1956).

The ultra tau-meter method is used to measure the mean decay times for the various phosphors giving for barium platino-cyanide a value of 8×10^{-7}sec, for potassium platino-cyanide values between 1 and 15×10^{-7}sec over the range 20°C to -200°C, and for fluorite activated by europium a value of 6.5×10^{-7}sec with activation energy for thermal quenching in the latter case of 0.7 eV. G.F.J.Garlick

535.37

8113. THE QUANTUM YIELD OF THE RED LUMINESCENCE OF CADMIUM SULPHIDE AT ROOM TEMPERATURE AND FOR EXCITATION WITH U.V. LIGHT. E.Waibel and R.Seiwert.
Z. phys. Chem. (Leipzig), Vol. 205, No. 5, 266-84 (April, 1956).

A discussion of the measuring technique for determination of the quantum yield of luminescence is given. A value of 0.2 is obtained for the maximum efficiency of a CdS phosphor excited by 3650 A radiation. G.J.F.Garlick

535.371

8114. ON THE FLUORESCENCE OF PARACHLOROTOLUENE IN THE SOLID STATE AT LOW TEMPERATURE. D.C.Biswas.
Indian J. Phys., Vol. 30, No. 3, 143-50 (March, 1956).

The fluorescence spectra of pure p-chlorotoluene in the solid state at -30°C and -180°C have been investigated using filtered Hg radiation and the spectrum has been compared with those due to frozen solutions of the substance in benzene, n-heptane, methyl cyclohexane, methyl alcohol, carbon tetrachloride, tetrachloroethylene and carbon disulphide of different concentrations. Altogether eight bands are produced by the pure substance and these diminish in intensity abruptly as the temperature of the solidified mass is raised from -180°C to -30°C. The bands persist with undiminished intensity even in the case of a 2% solution of the substance in benzene, carbon tetrachloride and tetrachloroethylene at -180°C. In the case of solution in methyl cyclohexane, n-heptane and methyl alcohol at -180°C, strong new bands appear in the fluorescence spectra. When the substance is dissolved in carbon disulphide and the solution is frozen and cooled to -180°C, the bands persist up to 15% concentration, but the intensities of the bands diminish rapidly and the bands almost disappear as the concentration is reduced to 5%. The results are explained on the assumption that the formation of virtual links between the chlorine and hydrogen atoms of the p-chlorotoluene molecule respectively with hydrogen and chlorine atoms of the neighbouring molecules in the solidified mass is responsible for the production of the metastable states giving rise to the observed fluoresence. It is pointed out that the absence of fluorescence in very dilute frozen solutions in carbon disulphide corroborates this hypothesis. A.

535.371

8115. LUMINESCENCE PROPERTIES OF ZINC-INTERCHALCOGENIDES. I. ZINC SULFO-TELLURIDE PHOSPHORS. S.Larach, W.H.McCarroll and R.E.Shrader.
J. phys. Chem., Vol. 60, No. 5, 604-8 (May, 1956).

These materials include (1) unactivated and unfluxed phosphors, (2) unactivated phosphors, prepared with NaCl flux, (3) phosphors with Ag activator and with NaCl flux, (4) phosphors with Cu activator and with NaCl flux, (5) phosphors with Mn activator, with and without NaCl flux. X-ray studies show the solubility limit of ZnTe in ZnS to be approximately eight mole %. With increasing proportion of ZnTe, the peak wavelength of emission from Zn(S:Te) phosphors generally occurs at longer wavelengths. Phosphors prepared with Mn activator exhibit two emission bands. One band, attributed to the centres responsible for the emission from Zn(S:Te):NaCl, is modified by the presence of Mn; the second band is due to the emission from Mn centres perturbed by chloride. A.

535.371

8116. RESEARCHES ON THE LUMINESCENCE OF CADMIUM SULPHIDE ACTIVATED BY SILVER. M.Bancie-Grillot and E.Grillot.
J. Chim. phys., Vol. 53, No. 6, 521-6 (June, 1956). In French.

Silver activation is held to produce two types of emission centre with respective emission peaks at 0.73 and 0.78 μ. The first type of centre is reduced and the second type increased in efficiency by raising the firing temperature. G.F.J.Garlick

535.372

8117. PHOSPHORESCENCE SPECTRA OF THE β-HALONAPHTHALENES. J.W.Sidman.
J. chem. Phys., Vol. 25, No. 2, 229-33 (Aug., 1956).

The $^3L_a \rightarrow {}^1A$ phosphorescence spectra have been studied at 20°K in crystals and in dilute solid solutions in naphthalene and in each other. No phosphorescence was observed at 300°K or at 77°K in the pure or mixed crystals. The phosphorescence spectra at 20°K are sharp in the solid solution in naphthalene, whereas the spectra of the pure crystals or of the solid solutions in the β-halonaphthalenes are broad. The spectra are similar in energy and vibrational structure. The vibrational frequencies which appear in the spectrum can be related to those of naphthalene. From the vibrational analysis, it is concluded that the molecule possesses the same elements of symmetry in both ground and triplet states. Quenching by impurities in the purest obtainable crystals of naphthalene made it impossible to observe the naphthalene phosphorescence. The causes for broadening in low temperature electronic spectra are discussed. A.

535.372

8118. ON AN ARRANGEMENT FOR THE SPECTRAL ANALYSIS OF MOLECULAR PHOSPHORESCENCE AT ORDINARY TEMPERATURES. R.Lochet, F.Valentin and A.Rousset.
J. Phys. Radium, Vol. 17, No. 3, 307-8 (March, 1956). In French.

535.373

8119. NOTE ON THE THEORY OF THE POLARIZATION OF PHOTOLUMINESCENCE OF SOLUTIONS. A.Jabłoński.
Acta phys. Polon., Vol. 14, No. 6, 497-9 (1955).

535.375.5.08

8120. INVESTIGATIONS ON THE IMPROVEMENT OF THE TECHNIQUE OF RAMAN SPECTROSCOPIC PHOTOGRAPHY. I. THE DEVELOPMENT OF NEW Hg LAMPS. A.Simon, H.Kriegsmann and E.Steger.

Z. phys. Chem. (Leipzig), Vol. 205, No. 4, 190-201 (March, 1956). In German.

The lamp (for d.c. or a.c. and watercooled) operates with "medium pressure" discharge. Comparison is made between the intensities of and Raman spectra taken by lamps of the high pressure and present types. Various forms of the lamp are described. A favourable distribution of intensity in the blue triplet is given by the lamp. W.Good

535.375.5.08

8121. CONTRIBUTION TO THE IMPROVEMENT OF THE TECHNIQUE OF RAMAN SPECTROSCOPIC PHOTOGRAPHY. II. AN APPARATUS FOR POWDER PHOTOGRAPHS.
A.Simon, H.Kriegsmann and E.Steger.
Z. phys. Chem. (Leipzig), Vol. 205, No. 4, 181-9 (March, 1956). In German.

The improvements claimed are (1) the use of "medium " pressure Hg lamps giving low background intensity, (2) an arrangement permitting the use of three of the (water-cooled) lamps, (3) the use of conical holders for the powders, (4) the introduction of a metal interference filter to improve the quality of the secondary radiation without unduly increasing the exposure time. W.Good

535.375.54

8122. RAMAN SPECTRUM OF MAGNESIUM OXIDE.
S.J.Khambátá.
Proc. Phys. Soc. A, Vol. 69, Pt 5, 426-7 (May, 1956).

Investigations on thin crystal deposits of MgO have enabled the two lines corresponding to the Raman frequencies 617 cm^{-1} and 355 cm^{-1} to be recorded. Details of measurement technique and of the preparation of the crystal deposits are given. G.I.W.Llewelyn

535.375.55

8123. RAMAN SPECTRA OF FROZEN SOLUTIONS OF TOLUENE AND BENZENE IN ALIPHATIC SOLVENTS.
G.S.Kastha.
Indian J. Phys., Vol. 30, No. 6, 313-18 (June, 1956).

The Raman spectra of frozen solutions of toluene in ethyl alcohol of strengths 81.5% and 35.4% and of benzene in solutions of ethyl alcohol (35.5%), cyclohexane (18%) and cyclohexanol (32%) at -180°C have been studied. In the first two cases the spectra show a continuous wing accompanying the Rayleigh line, there being a strong band at 95 cm^{-1} in the first case. It has been pointed out that the band at 95 cm^{-1} in the case of solution of strength 81.5% is probably formed by the coalescence of the two discrete lines at 86 cm^{-1} and 108 cm^{-1} found in the spectrum due to pure toluene in the solid state at -180°C, and that these lines are due to vibrations in groups of toluene molecules formed by virtual linkages amongst neighbouring molecules, some of which break up into single molecules when the strength is reduced to 35.4%; and that the continuous wing may be due to oscillations in groups formed by association of toluene molecule with ethyl alcohol molecules. In all the spectra due to the frozen solutions of benzene in different solvents at -180°C the new low-frequency lines appear with the same intensities and at the same positions as in the case of pure benzene in the solid state at -180°C. From considerations of the relative densities of the solvents and of the solute, the solubility and the persistence of the low-frequency Raman lines with undiminished intensity in the spectra of these frozen solutions, it has been concluded that these lines are due to oscillations in small groups of molecules which are always present in concentrated solutions of the aromatic molecules in the solvents mentioned above. A.

535.375.56

8124. THE RAMAN SPECTRUM OF ETHYLENE.
T.Feldman, J.Romanki and H.L.Welsh.
Canad. J. Phys., Vol. 34, No. 8, 737-44 (Aug., 1956).

The vibrational Raman spectrum of ethylene was photographed at gas pressures of 1-3 atm with a reciprocal linear dispersion of 10.5 cm^{-1} per mm. The rotational structures of the totally symmetric bands, ν_1 and ν_3, were analysed using an approximate asymmetric top model; only the Q branch of ν_3 was observed. In the complicated structure of the non-totally symmetric ν_8 band a series of $^{O,S}Q_K$ branches was identified and the band origin determined as 3102.5 cm^{-1}. A satisfactory interpretation of a broad maximum at 1662 cm^{-1} could not be given. A.

535.376

8125. THE LUMINESCENT RESPONSE OF SILVER ACTIVATED ZINC SULPHIDE TO LITHIUM IONS OF DIFFERENT ENERGIES. C.F.Eve and H.E.Duckworth.
Canad. J. Phys., Vol. 34, No. 8, 896-7 (Aug., 1956).

The variation of luminescence intensity with lithium ion energy over the range 15-40 keV is measured. A power law relation with an index of 2.5 is obtained. G.F.J.Garlick

535.376

8126. ON THE LUMINESCENT BEHAVIORS OF ZnS PHOSPHORS UNDER THE INFLUENCE OF A.C. ELECTRIC FIELD
K.Asagoe and N.Tani.
Sci. of Light (Tokyo), Vol. 4, No. 1, 7-15 (Aug., 1955).

The Gudden–Pohl effect of some electroluminescent phosphors ZnS:Cu and ZnS:Mn has been investigated. These phosphors had been kept in darkness at a room temperature for a definite time after being irradiated by continuous ultraviolet radiation ranging from 3300 A to 3900 A and then a 60 c/s a.c. electric field was applied. The Gudden–Pohl luminescence thus obtained was observed mainly by means of a cathode-ray oscilloscope. Some qualitative features of their "Auslösung" phenomena are ascertained. From close investigations of the oscillograms, the "Auslösung" of ZnS:Cu at "field on" is observed as stimulation and quenching luminescence depending on the field intensity, and in ZnS:Mn the field dependency of the stimulation is also observed. It is also suggested that the light sum of the phosphor luminescence may be measurable. The mechanism of the electroluminescence and that of electrophotoluminescence are considered probably different from each other in their excitation processes. A.

535.37

8127. LUMINESCENCE OF Al ALLOYS IN AN ELECTROLYTIC BATH. V.A.Krasnokut-skiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 192-3 (1956). In Russian.

It was found that, when a.c. or d.c. was passed through electrodes made of pure Al or its alloys in solutions of different electrolytes (alkalies or non-halogenous salts), a luminescence of the whole electrode surface was easily perceivable in darkness. Other metals (Cu, bronze, brass, Pb, Zn, Mg, Fe, Ag) failed to give this effect. The colour of the luminescence depended on the chemical nature of the electrode and was independent of the electrolyte. Observations point to a relationsh between the protective oxide film and the luminescence. Highest luminescence was observed in solutions of $NaHCO_3$, Na phosphates, NaOH and KOH. F.Lachma

535.391

8128. GRAPHICAL METHOD OF CALCULATING MULTILAYER COATINGS. P.G.Kard.
Dokl. Akad. Nauk SSSR, Vol. 108, No. 1, 60-3 (1956). In Russian.

A general formula is developed for calculating the amplitude coefficient of reflection from a coating containing (k + 1) layers if that for a coating with k layers is known:

$$r_{k+1} = [a_k + r_k \exp(2i\delta_k)]/[1 + a_k r_k \exp(2i\delta_k)],$$

where $\delta_k = k_0 n_k d_k \cos\theta_k$, k_0 = the wave number in vacuum, n_k = the refractive index in the k-th layer, d_k = the thickness of that layer, θ_k = the angle of incidence for the amplitude coefficient of reflection equal to r_k, and a_k = the amplitude coefficient of reflection at the k/(k + 1) boundary. A double

net of coordinates (bipolar and polar coordinates within one circle) makes it possible to find the coefficient of reflection for a given multi-layer coating and a given angle of incidence θ.
F.Lachman

535.391 : 539.23

8129. REFLECTION AND TRANSMISSION OF LIGHT BY A SYSTEM OF THIN AND THICK DIELECTRIC LAYERS. M.P.Lisitsa.
Zh. tekh. Fiz., Vol. 24, No. 10, 1837-50 (1954). In Russian.

Recurrent and general formulae are given for determination of the intensity of the reflected and the transmitted beams of light for a system consisting of a number of thin or thick isotropic layers. Specific examples of application of the general formulae are given for the case of transparent coatings. A.

535.391 : 539.23

8130. TOWARDS THE THEORY OF MULTILAYER TWO-COMPONENT DIELECTRIC COATINGS. V.V.Sukhanovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 2, 226-9 (1956). In Russian.

The theory has been treated by many authors but incompletely. Lisitsa (see preceding abstract) has used the formulae which are cumbersome and not too accurate in practice. In the most common case of two layers of alternately high and low refractive index the methods of matrix algebra may be used. The coefficient of reflection is evaluated and plotted for 5, 7 and 9 layers of ZnS–cryolite alternately. The phase change is calculated and plotted for the same system as a function of the angle of incidence. W.Bardsley

535.411

8131. OPTICAL CHARACTERISTICS OF COMPOUND INTERFERENCE LIGHT-FILTERS. K.D.Sinel'nikov, I.N.Shklyarevskiĭ and N.A.Vlasenko.
Zh. tekh. Fiz., Vol. 26, No. 1, 96-101 (1956). In Russian.

It was shown in a previous paper (Sinel'nikov, Shklyarevskiĭ and Damashka, Uchenye Zapiski Khar'kovskogo gosudarstvennogo Universiteta, Trudy fizicheskogo Otdeleniya, Vol. 6, 147, 1955) that, by coordinating a light filter of the first order with a filter transmitting 10-15 bands, the transmission band can be narrowed down to 1/10-1/12, whereas the magnitude of transmission is only reduced by up to 25%. The method used in both the present and the previous paper consists in clamping a glass plate with a highly-reflecting coating to the interference filter of first order, which transmits in the visible region one band with the maximum λ_0, so as to form a wedge-shaped air-gap between the reflecting surfaces of the two elements; this compound filter is fixed in front of the spectrograph slit to which the edge of the wedge is parallel. The recording spectrometer DFS-4 was used in the research. The interference filters were made of Ag and BaF_2 coatings, the third reflecting coating consisting sometimes of ZnS or ZnS with cryolite. Several diagrams (transmission bands) and a table (coefficients of reflection of different outer reflecting coatings, the corresponding transparency and the half-width of transmission bands) illustrate the results. In agreement with simple theory best results were obtained with filters in which the middle reflecting layer had a greater coefficient of reflection than the first reflecting coating. The best third layer was provided by three-layer or five-layer dielectric coatings. F.Lachman

535.417

8132. ON THE CONTRAST AND WIDTH OF REFLECTED MULTIPLE-BEAM INTERFERENCE FRINGES. K.Miyake.
Sci. of Light (Tokyo), Vol. 4, No. 2, 113-19 (Nov., 1955).

Discusses (1) under what condition the reflected multiple-beam interference fringes attain high contrast, and (2) if the condition is not fulfilled, how the contrast is weakened. As for the definition of the width, instead of the customary width for one half of the maximum intensity, the width where the intensity becomes $1/2(I_{max} + I_{min})$ is proposed, as not only is it more reasonable, but also the formula for the width becomes much simpler. A.

535.421

8133. ON PREPARING PLASTIC COPIES OF DIFFRACTION GRATINGS — AN EXTENSION TO THE MERTON-N.P.L. PROCESS. G.D.Dew.
J. sci. Instrum., Vol. 33, No. 9, 348-53 (Sept., 1956).

A process is described whereby a number of glass-based plastic copies may be prepared from a Merton-N.P.L. gelatine replica grating. These copies, considerably more stable than the gelatine replicas, may be employed as transmission gratings or aluminized and used by reflection. By using plate glass blanks it is possible to reduce production costs while obtaining an optical quality almost indistinguishable from that of the patent replica. For moiré fringe counting applications the process may be employed in preparing copies many times the length of the original grating, all the sections being parallel and in phase. Copies prepared in this way may be recopied a number of times by the use of a slightly modified process. A.

535.43 : 535.36

8134. DIFFUSED RADIATION IN SEMI-INFINITE AND THICK PLANE PARALLEL DIFFUSERS WITH A LINE SOURCE PARALLEL TO THE SURFACE. R.G.Giovanelli.
Optica Acta, Vol. 3, No. 2, 49-55 (June, 1956).

Formulae are derived for the total intensity of diffused radiation within or at the surface of semi-infinite and thick plane parallel diffusers with a line source parallel to the surface and lying in, or on the surface of the diffuser. Some numerical results are included. A.

535.43 : 539.11

8135. SCATTER FORMULAE OF THE QUANTUM OPTICS OF METALS FOR THE INFRARED SPECTRUM REGION IN MULTI-ELECTRON THEORY. V.I.Cherepanov.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 598 (1956). In Russian.

Develops the following formulae: (1) for the permittivity $\epsilon = 1 - 4\pi e^2 S^*/m(\omega^2 + \Gamma^2)$, and (2) for conductivity $\sigma = e^2\Gamma S^*/m(\omega^2 + \Gamma^2)$, where e and m are the charge and the mass of the electron, respectively, ω = the frequency of light, Γ = the extinction factor, and S* a tensor equivalent of the effective number of conductivity electrons. A special case of the given formulae is the Vonsovskiĭ formula (Abstr. 3987/1949). F.Lachman

535.551 : 541.64

8136. TEMPERATURE DEPENDENCE OF PHOTO-ELASTIC CONSTANTS IN PLASTICS. S.Bhagavantam and Y.Krishna Murty.
Proc. Indian Acad. Sci. A, Vol. 43, No. 4, 203-9 (April, 1956).

The birefringence produced in samples of polymethyl methacrylate and polystyrene when subjected to stress was measured at different temperatures employing a Babinet compensator. Graphs of birefringence against temperature plotted for the temperature range 30 to 90°C for perspex under 100 kg/cm² stress and for polystyrene under 60 kg/cm². The birefringence of the stressed methacrylate is positive and for polystyrene it is negative. The birefringence in the case of perspex increases with temperature while in polystyrene it shows a decrease as the temperature increases. There is a transition point at 62°C for perspex and at 70°C for polystyrene. The relative stress-optic and strain-optic constants are evaluated at each temperature taking into consideration the temperature variation of the refractive index. A.

535.557

8137. DYNAMICAL BIREFRINGENCE OF POLYMETHYL-METHACRYLATE SOLUTIONS WITH VARIOUS SOLVENTS AND THE FORM OF THE MACROMOLECULES. V.N.Tsvetkov, É.V.Frisman and L.S.Mukhina.
Zh. éksper. teor. Fiz., Vol. 30, No. 4, 649-60 (1956). In Russian.

An investigation of two fractions ($M = 3.5 \times 10^5$ and $M = 4.2 \times 10^6$) of polymethylmethacrylate in various solvents was carried out. The results are compared with the theories based on the anisotropic ellipsoidal micelles model and viscoelastic sphere model. The experimental results are found to be in better agreement with the anisotropic micelles model. A.

535.64 : 621.327.43

8138. COLOR RENDITION WITH FLUORESCENT SOURCES OF ILLUMINATION. H.Helson, D.B.Judd and M.Wilson.
Illum. Engng, Vol. 51, No. 4, 329-46 (April, 1956).

A study of a method of predicting the changes of appearance of coloured objects when illuminated by three typical kinds of fluorescent lamps assigned the colour temps. 3500°, 4500° and 6500° respectively, the appearance under daylight being taken as basic. The results of observations made by five subjects on 130 Munsell samples, viewed against a grey background, are tabulated. The observers were in all cases conditioned to the light illuminating the sample. The results are compared with those predicted by means of formulae similar to that developed previously in similar work with tungsten lamps (Abstr. 6442/1952). When the average results of the five observers are taken, the agreement is satisfactory, but the individual values vary widely among themselves.
J.W.T.Walsh

535.65 : 535.89

8139. SOURCES OF ILLUMINATION IN ACCURATE COLOUR MEASUREMENTS OF NON-SELFLUMINOUS BODIES. G.N.Rautian, N.V.Lobanova and M.A.Znamenskaya.
Zh. tekh. Fiz., Vol. 26, No. 1, 193-202 (1956). In Russian.

Recommends replacing Davis and Gibson's liquid filters (International Commission on Illumination, 1931), used in conjunction with a lamp standardized by its colour temperature, by theoretical standards based on Planck's law for an absolutely black body. It is claimed that triple-glass light filters developed in the U.S.S.R. by Ronis in 1948 are more convenient in use, more accurate and ensure better standardization than liquid filters. A method is described of designing compound glass filters that, combined with the standard source A_0 (2854°K; a substandard electric incandescent lamp with W spiral is actually proposed), would yield the white illumination sources B_0 and C_0. F.Lachman

535.65 : 535.89

8140. REMARKS ON THE PAPER "SOURCES OF ILLUMINATION IN ACCURATE COLOUR MEASUREMENTS OF NON-SELFLUMINOUS BODIES" BY G.N.RAUTIAN, N.V.LOBANOVA AND M.A.ZNAMENSKAYA. A.I.Tudorovskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 1, 237-8 (1956). In Russian.

The theoretical basis of the proposed standard illumination sources (see preceding abstract) is disputed. F.Lachman

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.822.9 : 778.34

8141. MICROSCOPE FOR LARGE NUCLEAR PLATES. G.T.Zorn.
Rev. sci. Instrum., Vol. 27, No. 8, 628-30 (Aug., 1956).

A precision microscope which may be used with all sizes of nuclear plates up to 10 x 16 in. has been constructed. Its simplicity of construction, and flexibility and ease of use recommend its general design. A.

535.87 : 531.717.82

8142. PRODUCTION OF A MERCURY MIRROR WHICH IS INSENSITIVE TO SHOCKS AND ITS APPLICATION AS A FLATNESS STANDARD. R.Bünnagel.
Optica Acta, Vol. 3, No. 2, 81-4 (June, 1956). In German.

A mercury mirror which is insensitive to vibration consists of a layer of mercury about 0.2 mm thick. The formation of such a thin layer is achieved by using a vessel of a metal which readily forms an amalgam. By silvering the inner surface of the metal vessel the mirror is made durable, and the formation of a skin on the mercury surface is prevented. The flatness of the mercury mirror has been tested by two different interferometric methods, and its suitability as a standard flat established. Multiple beam interferometry may be used to increase the accuracy of the testing for flatness. As every liquid mirror flows when its position is slowly changed, a firm mounting is necessary. A.

HEAT 536

536.212 : 536.48

8143. THERMAL CONDUCTIVITY OF GERMANIUM AND SILICON AT LOW TEMPERATURES. G.K.White and S.B.Woods.
Phys. Rev., Vol. 103, No. 3, 569-71 (Aug. 1, 1956).

Measurements are reported of the thermal conductivity, K, of high-purity n- and p-type germanium, and of a single crystal of n-type silicon at temperatures between 2 and 150°K. These confirm that in silicon and in annealed germanium the thermal conductivity is limited only by boundary scattering at temperatures below about $\theta/100$, where θ is the Debye characteristic temperature; while at temperatures above $\theta/10$, $K \propto T^{-n}$ where $n \cong 1.3$ for germanium and $n \cong 1.0$ for silicon. In the range of temperature just above the conductivity maximum, that is, from $\theta/20$ to $\theta/10$, no particularly rapid rate of change of K with T is observed, in contrast with the behaviour found in pure dielectric crystals and bismuth. These features are discussed. A.

536.212.3

8144. ON THE DETERMINATION OF THE TEMPERATURE DEPENDENCE OF THERMAL CONDUCTIVITY. L.A.Vulis and V.A.Potseluĭko.
Zh. tekh. Fiz., Vol. 26, No. 1, 76-87 (1956). In Russian.

A procedure for determining the true mean temperature in thermal conductivity measurements by the steady state and transient heat flow methods is described. It is a successive approximation procedure in which the most likely shape of the temperature dependence of thermal conductivity is first selected and then modified (or verified) by an analysis of experimental data. The following results are reported for sand in the range 20-300°C: thermal conductivity $\lambda = \lambda_0(1 + \alpha t)$, where $\alpha = (1.2 \pm 0.1) \times 10^{-3}$ deg^{-1} and $\lambda_0 = (10.3 \pm 0.8) \times 10^{-4}$ cal/(cm.sec.deg) by the stationary method and $\lambda_0 = (10.2 \pm 0.2) \times 10^{-4}$ cal/(cm.sec.deg) by the transient method. Heat capacity in the range 0-250°C is $0.17(1 + 2.4 \times 10^{-3}t)$ cal/(g.deg); and thermal diffusivity $3.8(1 - 10^{-3}t) \times 10^{-3}$ cm^2/sec.
A.Gelbtuch

536.212.3

8145. DETERMINATION OF THERMAL CONDUCTIVITY OF FRIABLE MATERIALS BY THE MAL'MGREN-SHULEĬKEN METHOD. L.A.Vulis, N.D.Kosov and V.A.Potseluĭko.
Zh. tekh. Fiz., Vol. 26, No. 1, 85-9 (1956). In Russian.

Thermal conductivity of various sands and magnesia was determined by a transient heat flow method consisting of measuring the temperature difference Δt at two concentric cylindrical surfaces a small distance (Δr) apart. A line heat source at the axis of the cylinder is first energized and later de-energized, the outer surface of the cylinder being kept at a constant temperature. Δt will thus at first rise and then decrease until $\Delta t \cong 0$. Thermal conductivity is found, on the assumption that it is independent of temperature, from $\lambda = Q/S \int_0^\infty (\Delta t/\Delta r) d\tau$, where Q is the heat passing through a surface of area S, and τ is time. The apparatus is described.
A.Gelbtuch

536.253

8146. ON THE CONVECTION OF HEAT FROM A WIRE MOVING THROUGH AIR CLOSE TO A COOLING SURFACE. N.A.V.Piercy, E.G.Richardson and H.F.Winny.
Proc. Phys. Soc. B, Vol. 69, Pt 7, 731-42 (July, 1956).

Renewed interest in the measurement of fluid velocities in boundary layers by the hot-wire method has called attention to a difficulty that arises when the wire approaches a conducting body of lower temperature. The additional convection caused by the body may be large and is not easy to assess by experiment alone, while theoretical investigation is somewhat complicated. Some time ago, the present authors obtained an approximate solution of the cognate problem of a hot wire moving adjacently to a cooling flat plate through an inviscid fluid, assumed to be initially stationary, and found a measure of agreement with corresponding experiments which they conducted in air. It is anticipated that the results should provide reliable corrections in the practical problem when the wire is small compared with the thickness of the boundary layer and sufficiently clear of the surface of the body. Section 1 of the present paper gives an account of the analysis, which is in the nature of a development of the work of King and of Piercy and Winny. Section 2 records observations of the cooling of a hot wire whirled through air round a large circular brass cylinder of normal temperature. The results of the experiments are compared with the theory by means of examples worked from the final equations. A.

536.33.08

8147. A SEMI-CONDUCTING ANTIMONY BOLOMETER. E.J.Gillham.
J. sci. Instrum., Vol. 33, No. 9, 338-41 (Sept., 1956).

Thin films of a semiconducting form of antimony prepared by sputtering from a cathode of metallic antimony are suitable, with regard to resistivity, temperature coefficient of resistance and freedom from current noise, for the construction of bolometers of good sensitivity and of sufficiently high resistance for matching into a valve amplifier. A description is given of the construction and performance of such a bolometer, in which the antimony film is deposited on a thin plastic pellicle. A.

536.41

8148. THE EXPANSION OF MERCURY AND FUSED SILICA BETWEEN 0 AND 300°C. A.H.Cook.
Brit. J. appl. Phys., Vol. 7, No. 8, 285-93 (Aug., 1956).

The determinations of the thermal expansion of mercury and fused silica have been reviewed. In principle the absolute hydrostatic balancing method is a more satisfactory way of measuring the expansion of mercury than deducing it from the expansion relative to a fused silica bulb, but a discussion of the determinations shows that despite the variability of the expansion of fused silica from specimen to specimen, systematic errors affecting the absolute determinations make them less reliable than the relative measurements of Harlow and Beattie and others. It is recommended that for the most accurate work, the expansion formula given by the latter authors should be used instead of that given by Sears. The present uncertainty of the change of volume with temperature is about one or two parts in a million of the volume at 0° C for temperatures from 0 to 300°C, and may be as much as one part in ten thousand at other temperatures. A.

536.42 : 537.29

8149. INFLUENCE OF AN ELECTRIC FIELD ON THE TRANSITION TEMPERATURE OF FIRST- AND SECOND-ORDER TRANSFORMATIONS. L.Reinisch.
C.R. Acad. Sci. (Paris), Vol. 243, No. 1, 30-2 (July 2, 1956). In French.

It is shown that for transformations of the first order an electric field may raise or lower the transition temperature but the charge is, in general, small. For second-order transformations the effect is always to produce a lowering of the transition temperature. F.E.Hoare

536.421.4 : 548.5

8150. ORIENTATED FREEZING OF SUPERCOOLED WATER ON CRYSTALLINE SURFACES. I. ON MUSCOVITE MICA. J. Jaffray and R.Montmory.
C.R. Acad. Sci. (Paris), Vol. 243, No. 2, 126-9 (July 9, 1956). In French.

A cloud of supercooled water droplets condenses on newly cleaved mica surfaces at −20° C, forming orientated ice crystals in two directions. In one orientation [010] of the mica is parallel to $[10\bar{1}0]$ of the ice, in the other [010] of the mica is parallel to $[11\bar{2}0]$ of the ice. In these two directions the lattices of mica and ice are a fairly close fit. C.Turner

536.46 : 535.23.08

SPECTRAL RADIANT INTENSITY OF HYDROCARBON FLAMES. See Abstr. 7246

536.461

8151. GROWTH RATES OF TURBULENT FREE FLAMES. W.R.Mickelsen and N.E.Ernstein.
J. chem. Phys., Vol. 25, No. 3, 485-9 (Sept., 1956).

Effective flame speeds of turbulent free flames were measured by photographic, ionization gap, and photo-multiplier tube methods; they were found to have a statistical distribution attributed to the random nature of the turbulent field. The effective turbulent flame speeds for the free flame were found to be less than those previously measured for flames seated on Bunsen burners and bluff bodies. The statistical spread of the effective turbulent flame speeds was markedly wider in the lean and rich fuel–air regions. This is attributed to the greater sensitivity of laminar flame speed to flame temperature in the lean and rich regions. A.

536.48

8152. THE EFFECT OF THE RATE OF MOVEMENT OF A FILM OF He II UPON ITS THICKNESS. V.M.Kontorovich.
Zh. éksper. teor. Fiz., Vol. 30, No. 4, 805 (1956). In Russian.

The thickness of the helium film as a function of its velocity is calculated using the two-fluid model. It is found that a film moving with a typical velocity has a thickness between 1 and 10% less than when at rest. J.M.Radcliffe

536.628.2 : 536.48

8153. ADIABATIC SPECIFIC HEAT CALORIMETER FOR THE TEMPERATURE RANGE 4 to 15° K. M.H.Aven, R.S.Craig and W.E.Wallace.
Rev. sci. Instrum., Vol. 27, No. 8, 623-8 (Aug., 1956).

A calorimeter bridging the interval between liquid helium and liquid hydrogen temperatures is described. The instrument uses a constant volume helium gas thermometer as the working thermometer. The sample is placed directly in the gas thermometer bulb which thus acts as a sample container. The use of the calorimeter is restricted to bulk samples with low surface areas. A.

536.631 : 548.7

CALCULATION OF THE MEAN DEBYE TEMPERATURE OF CUBIC CRYSTALS. See Abstr. 7812

536.658 : 535.231

A NEW METHOD OF MEASURING THE TOTAL EMISSIVITY AND THE ACCOMMODATION FACTOR OF A SURFACE. See Abstr. 7247

THERMODYNAMICS 536.7/.8

536.7

8154. THERMODYNAMIC THEORY OF IRREVERSIBLE PROCESSES. I. THE BASIC MACROSCOPIC CONCEPTS. D.G.Miller.

Amer. J. Phys., Vol. 24, No. 6, 433-44 (Sept., 1956).

The foundations of the thermodynamic theory of irreversible processes are presented in macroscopic terms. The concept of entropy production in systems with gradients is discussed in relation to classical thermodynamics and to what new hypotheses are necessary. The entropy production is computed in some simple cases, and it is found that its factors can be related to well-known linear laws such as Ohm's. It is shown on experimental grounds that the linear laws must be generalized in complex cases involving interacting flows. Further appeal to experiment shows that the Onsager relations must be valid. The range of validity of the theory is discussed. A.

536.7 : 532.72 : 533.15

8155. THERMODYNAMICS OF DIFFUSION IN MULTICOMPONENT SYSTEMS. G.J.Hooyman.
Physica, Vol. 22, No. 8, 751-9 (Aug., 1956).

The phenomenological description of diffusion in isotropic mixtures is developed from the expression for the entropy production and the relations between the diffusion coefficients, resulting from the Onsager relations, are derived. The results are specified for ternary mixtures. A.

536.7 : 541.18.043

8156. THERMODYNAMICS OF SEDIMENTATION IN PAUCIDISPERSE SYSTEMS. G.J.Hooyman.
Physica, Vol. 22, No. 8, 761-9 (Aug., 1956).

The previous treatment of sedimentation phenomena in monodisperse uncharged systems (Abstr. 2384/1954) is extended to paucidisperse systems. The sedimentation rates of the components are derived by neglecting transverse effects and by introducing the boundary condition of vanishing volume flow. The results are specified for ternary ideal mixtures and the sedimentation coefficients are expressed in terms of diffusion coefficients. The equations obtained might account for two effects, established experimentally (i) an anomalous behaviour of slowly sedimenting material above the boundary layer of more rapidly sedimenting components and (ii) the occurrence of a backward flow in experiments with the "synthetic boundary cell", where slowly sedimenting materials are mixed with more rapidly sedimenting ones. A.

536.7 : 530.162

A NEW METHOD IN STATISTICAL MECHANICS. See Abstr. 7161

ELECTRICITY 537

ELECTROSTATICS. DIELECTRICS 537.2

537.212 : 538.3

8157. DISTRIBUTIONS OF THE SINGULARITIES IN THE ELECTROSTATIC AND ELECTROMAGNETIC FIELDS. E.Durand.
Ann. sci. École Normale Supér., Vol. 73, No. 1, 75-91 (Jan.-March, 1956). In French.

Since div grad (1/r) = 0 except at r = 0, this expression was usually omitted from formulae. But more satisfactory and more general expressions are obtained if the symbol div grad (1/r) is retained and treated as an ordinary function. Further expressions are obtained from it (e.g. by partial integration), which can be shown to have a physical meaning and can be calculated. The author calculates the volume integrals of div grad (1/r) dv and f. div grad (1/r) dv, where f is a given continuous function, and various similar surface and line integrals. It is shown in some detail that all expressions with singular points to which Laplace's formula can be applied can be treated in the same way as the regular functions. One can take their div, grad, curl and transform their multiple integrals as in the case of ordinary functions. This method is applied to expressions for the potential and to volume, surface and line distributions of electric point charges dipoles etc. and to find the magnetic field due to linear and surface currents. J.Smuts

537.213

8158. ON THE ATTEMPT TO DETERMINE EXPERIMENTALLY THE POTENTIAL DIFFERENCE AT THE SURFACE OF WATER. G.Passoth.
Z.Elektrochem, Vol. 60, No. 4, 420-3 (1956). In German.

On the assumption that within the surface layer the dielectric constant is smaller than in the interior of the water the potential difference at the surface is assessed at 0.2 to 0.3 volt. It is shown experimentally that the value determined by Chalmers and Pasquill (Phil. Mag., Vol. 23, 88, 1937) must be explained by contamination of the water surface by organic impurities. W.Good

537.222

8159. CHARGED RIGHT CIRCULAR CYLINDER. W.R.Smythe.
J. appl. Phys., Vol. 27, No. 8, 917-20 (Aug., 1956).

A new method permits the calculation of the electric field surrounding a charged conducting surface of revolution without the use of orthogonal functions. Detailed formulae show how to find the charge density on a right circular cylinder with any desired precision. The numerical examples worked out give the maximum deviation of the actual surface from that of a true cylinder of diameter d to be −0.0015d, −0.00037d, −0.00017d, +0.0016d, and +0.014d for length to diameter ratios $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, and 4, respectively. The capacitance calculation gives an accuracy of one part in 30 000 for the ratios $\frac{1}{2}$, 1, and 2. A capacitance formula is worked out which is accurate to one part in 1000 over the ratio range 0 to 4. Additional formulae indicate the method of solution for the bodies in longitudinal and transverse electric fields and the extension of two-body problems such as the thick plate parallel plate capacitor. A way to calculate the flow about bodies of revolution is indicated. Digital computers are well suited to this method as no function tables are needed. A.

537.226

8160. A DIELECTRIC LAYER WITH A SPHERICAL CAVITY IN A HOMOGENEOUS ELECTROSTATIC FIELD. R.N.Kaufman.
Dokl. Akad. Nauk SSSR, Vol. 101, No. 4, 633-6 (1955). In Russian.

A boundary value problem is solved using expansions in terms of Legendre functions. It deals with a plane dielectric layer of infinite extent parallel to the direction of the electric field with a spherical cavity equidistant from the boundary planes. Mathematical Reviews

537.226 : 548.7

DYNAMICS OF IONIC LATTICES OF FERROELECTRIC CRYSTALS IN LIMITING CASES. See Abstr. 7813

537.226.1

8161. VARIATION OF DIELECTRIC CONSTANT WITH TEMPERATURE. G.P.Srivastava and Y.P.Varshni.
Physica, Vol. 22, No. 7, 584-6 (July, 1956).

Five empirical formulae derived by previous authors are discussed in relation to Debye's equation. J.H.Mason

537.226.2/.3

8162. THE TEMPERATURE AND FREQUENCY DEPENDENCE OF THE DIELECTRIC CONSTANT AND LOSS ANGLE OF SOLID DIELECTRICS AT A WAVELENGTH OF 3 cm. G.I.Skanavi and G.A.Lipaeva.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 824-32 (1956). In Russian.

Results obtained by using a cylindrical resonant cavity

to measure ϵ and tan δ of magnesium, zinc, calcium, strontium and bismuth titanates, barium tetratitanate and of steatite are presented for $\lambda = 3$ cm. The frequency dependence of ϵ and tan δ of these materials was determined in a broad frequency range; the temperature dependence was investigated at 10^3, 10^6 and 10^{10} c/s. The results are discussed from the viewpoint of modern concepts concerning the nature of dielectric polarization. A.

537.226.2

8163. DIELECTRIC PROPERTIES OF POLAR SOLUTES IN NON-POLAR SOLVENTS AT MICROWAVE FREQUENCIES. D.E.Clark and S.N.Kumar.
Brit. J. appl. Phys., Vol. 7, No. 8, 282-4 (Aug., 1956).

The dielectric loss and permittivity of solutions of polar molecules in non-polar solvents have been measured at frequencies 9.2×10^9 c/s and 3.5×10^{10} c/s. At the lower frequency independent determinations of absorption and wavelength were made on solutions of benzophenone over the temperature range 10 to 30° C. At the higher frequency the solute investigated was nitromethane and the temperature range was 10 to 40° C. Values of dipole moments obtained were 2.95 Debye units and 2.85_6 Debye units for benzophenone and nitromethane respectively. A.

537.226.2 : 539.133

8164. DIELECTRIC PROPERTIES OF 2, 4-DINITROFLUOROBENZENE. D.V.G.L.Narasimha Rao.
Indian J. Phys., Vol. 30, No. 2, 91-4 (Feb., 1956).

The dipole moment of 2, 4-dinitrofluorobenzene in solution in benzene at 30° C and the value obtained, 3.56 D, is found to be in exact agreement with that calculated using the general method given by the author previously (1955). The absorption of the molecule at 3 cm, is also studied in the same solvent and a value of 3.30 D, for the dipole moment, and 5.3×10^{-11} sec for the relaxation time, are obtained. It is expected from the value of the relaxation time that the molecule will show maximum absorption near about 10 cm. A.

537.226.2

8165. DIELECTRIC EFFECTS PRODUCED BY SOLIDIFYING CERTAIN ORGANIC COMPOUNDS IN ELECTRIC OR MAGNETIC FIELDS. W.McMahon.
J. Amer. Chem. Soc., Vol. 78, No. 14, 3290-4 (July 20, 1956).

Several unexpected dielectric effects have been observed when certain organic compounds are solidified in electric or magnetic fields. When solidified in electric fields, either alternating or uni-directional, the dielectric constants of these compounds in the solid state becomes higher than normal. The increase in constant is isotropic, i.e., it appears to be the same in all directions and bears no relation to the direction of the field applied during solidification. However, when the compounds are allowed to solidify in a magnetic field an anisotropic change in dielectric constant is produced causing it to be greater than normal in the direction of the applied field and lower at right angles to this direction. An explanation of the effect produced by magnetic fields is offered which is based on the diamagnetic properties and behaviour of the compounds studied and their relation to dielectric properties. A.

537.226.2

8166. DIELECTRIC PROPERTIES OF CASTOR OIL AT HIGH PRESSURES. L.F.Vereshchagin, L.F.Kuznetsov and T.I.Alaeva.
Zh. éksper. teor. Fiz., Vol. 30, No. 4, 661-6 (1956). In Russian.

The dielectric permittivity and tan δ have been measured for castor oil at pressures up to 9000 atm and at various frequencies. It is shown that with increase of pressure the dielectric permittivity and tan δ go through a maximum, this being due to variation of viscosity with pressure. A.

537.226.2 : 537.312.62

DETERMINATION OF THE DIELECTRIC CONSTANT OF SUPERCONDUCTORS. See Abstr. 7432

537.226.2 : 539.11 : 535.523

ON THE THEORY OF THE TEMPERATURE DEPENDENCE OF THE DIELECTRIC CONSTANT OF HOMOPOLAR CRYSTALS. See Abstr. 7327

537.226.2 : 621.315.61

8167. THE HIGH DIELECTRIC CONSTANT OF NIOBATES AND TANTALATES OF DIVALENT METALS. G.A.Smolenskiĭ, V.A.Isupov and A.I.Agranovskaya.
Dokl. Akad. Nauk SSSR, Vol. 108, No. 2, 232-5 (1956). In Russian.

Niobates and tantalates of divalent metals have a high dielectric constant and negative temperature coefficient, except the metaniobate, metatitanate and pyroniobate of calcium. $Sr_2Ta_2O_7$ is a ferroelectric, whereas Hulm did not find spontaneous polarization in $Cd_2Ta_3O_7$ and $Pb_2Ta_2O_7$. The observed maxima of the temperature coefficients of ϵ and tan δ of $CdNb_2O_6$ do not correspond to ferroelectric phase transition, but have relaxation character.
Electrical Research Association

537.226.2 : 539.219 : 548.736.5

8168. STRUCTURE AND PHASE TRANSITIONS OF FERROELECTRIC SODIUM–CADMIUM NIOBATES. B.Lewis and E.A.D.White.
J. Electronics, Vol. 1, No. 6, 646-64 (May, 1956).

A study of the electrical properties and structure of ceramic specimens has shown that sodium–cadmium niobates form single phase solid solutions of the perovskite type. The cadmium niobate enters into solid solution as $CdNb_2O_6$ rather than in the more familiar form of $Cd_2Nb_2O_7$; pairs of sodium atoms in the $NaNbO_3$ lattice are replaced by one cadmium atom and one vacancy up to the composition with Na : Cd : vacancy in the ratio 6 : 1 : 1. Beyond this limit a second phase either $Cd_2Nb_2O_7$ or $CdNb_2O_6$ is always present. In the solution region a new tetragonal phase is introduced below the Curie temperature and ferroelectric properties are observed in this phase and in the orthorhombic phase which is displaced to lower temperatures. Superlattice effects indicate that throughout the solid solution range the structure cell is multiple compared with the simple perovskite cell. The ferroelectric properties are associated with a doubled unit cell, whereas antiferroelectric sodium niobate has a quadrupled cell. By observation of the superlattice lines which distinguish these multiple structure cells it has been possible to establish that for certain compositions, of fairly low cadmium niobate concentration, and in certain temperature regions, the ferroelectric and antiferroelectric structures coexist within the perovskite lattice. In this condition the properties are weakly ferroelectric. With increasing cadmium niobate content the proportion of antiferroelectric substructure decreases until the material is fully ferroelectric. A.

537.226.2 : 537.228.1 : 539.32

8169. A CALCULATION OF PHYSICAL CONSTANTS OF CERAMIC BARIUM TITANATE. M.Marutake.
J. Phys. Soc. Japan, Vol. 11, No. 8, 807-14 (Aug., 1956).

The dielectric, piezoelectric and elastic constants of polycrystalline ceramics at room temperature are calculated by averaging those values of single crystals on the assumption that the ceramic is composed of spherical crystallites. The calculated values are in good agreement with observed ones, showing that the piezoelectric effects in each single crystal (especially d_{15} at room temp.) play a great part in determining the properties of the ceramic. Also the method is shown for calculating elastic constants of polycrystals which consist of spherical crystallites in all directions, with the calculated values of metals (Au, Ag, Cu, Fe, etc.) in the cubic system.

The "destressing factor", which gives the relations between the internal stress of the sphere and the stress in the surrounding medium, is defined and calculated. A.

537.226.3 : 539.31

ANELASTICITY AND DIELECTRIC LOSS OF QUARTZ. See Abstr. 7753

537.226.31

8170. DIELECTRIC LOSSES IN ALKALINE BORON GLASSES AT LOW TEMPERATURES. V.A.Ioffe.
Zh. tekh. Fiz., Vol. 26, No. 3, 516-25 (1956). In Russian.

These losses are examined as a function of temperature in the range 12 to 300°K and for frequencies 0.24-1 Mc/s. The losses show a maximum at low temperatures, caused by relaxation movements of the elements of the structural lattice. In soda-potash-boron glasses neutralization effect is detected over the whole range of temperatures which indicates the strengthening of the glass structure when two alkali oxides are introduced instead of one. M.W.Makowski

537.226.8

8171. CHANGES IN THE DIELECTRIC CONSTANT OF CRYSTAL-PHOSPHORS IRRADIATED WITH X-RAYS. A.Skoglund and A.Ore.
Arch. Math. Naturvid., Vol. 53, No. 2, 16 pp. (1956).

Detailed measurements were performed on phosphorescent paint, which contained Cu-activated CaS and SrS (and possibly some ZnS). Diagrams are presented which illustrate the change in the dielectric constant during and after irradiation with 175 keV X-rays, and its dependence on dose rate. Essentially the static dielectric constant was studied, and at room temperature. The dielectric change in question is discussed as a possible basis for dosimetric methods, as well as for structural-functional analysis. A.

537.226.8 : 621.315.615.2

8172. SPACE-CHARGE LIMITED CURRENT IN INSULATING OIL. T.Sato, S.Nagao and Y.Toriyama.
Brit. J. appl. Phys., Vol. 7, No. 8, 297-8 (Aug., 1956).

In order to analyse the pre-breakdown phenomena in insulating oil, a hot tungsten filament emitting an abundance of electrons in a vacuum was employed as cathode. The gap between the electrodes was therefore only partly occupied by the liquid. Currents measured with various voltages and depths of oil were explained on the basis of space-charge limitation in the oil, and the mobility of the negative ion in transformer oil formed by the attachment of electrons to oil molecules was found to be 1×10^{-4} cm/s per V/cm. A.

537.226.8 : 621.315.61

8173. SOME RECENT STUDIES OF RANDOM NOISE BETWEEN METALS AND DIELECTRICS. S.I.Reynolds.
J. appl. Phys., Vol. 27, No. 7, 728-34 (July, 1956).

The purpose of these studies was to investigate the source of noise which is generated when thin dielectrics are subjected to relatively low d.c. voltages as reported by Boyer. It has been suggested by J.H.Mason that this phenomenon may be caused by the ionization in small voids due to poor electrode contact. Tests reported in this paper show that the application of 300 volts d.c. to dry films having a total resistance between test electrodes of 1.5 x 10 in.ohms was sufficient to give rise to a steady noise voltage if the electrodes were not in intimate contact. During some of the experimental work a two phase dielectric was subjected to d.c. voltage up to 1425 volts with no pulses. As expected, when the polarity was reversed, the d.c. current momentarily increased many-fold, and then during its decay, noise was measured simultaneously. The noise ceased when the d.c. current became constant. A similar phenomenon has been observed during the decay of the heterochange on a polarized dielectric. The test methods used provide a very sensitive method for detecting ionization in extremely small voids. A.

537.226.8 : 537.525

PRE-BREAKDOWN CURRENT AND VACUUM BREAKDOWN. See Abstr. 7443

537.228.1

8174. THE ELECTROMECHANICAL PROPERTIES OF SEIGNETTE [ROCHELLE] SALT. H.E.Müser.
Z.Phys., Vol. 145, No. 5, 621-38 (1956). In German.

Reference is made to the discrepancies in the published values of the dielectric, piezoelectric and elastic constants of Rochelle salt. Some of these discrepancies arise from neglect of the boundary conditions but if suitable corrections are made to allow for these, better agreement is observed. Special attention is paid to the influence of temperature on the properties mentioned and it is shown that, at room temperature, a Rochelle salt oscillator can be made having a frequency stability of $\pm$ 1 part in 10^4. H.J.H.Starks

537.311.1

8175. ON THE DETERMINATION OF MEAN FREE PATHS OF CONDUCTION ELECTRONS FROM GALVANOMAGNETIC EFFECTS. H.Scheffers.
Ann. Phys. (Leipzig), Vol. 18, No. 1-2, 29-34 (1956). In German.

A simple formula which is a particular form of Kohler's rule is obtained for the resistance variation of a pure monovalent metal in a transverse magnetic field at low temperatures Its application to experimental results on Au, Ag and Cu, together with the use of Fermi–Dirac statistics, enables the mean free paths to be determined. Good agreement is obtained with values obtained by other means such as the use of the anomalous skin effect. C.A.Hogarth

537.311.1 : 536.2.01

8176. THE CONCEPT OF FORMAL RELAXATION TIMES IN THE THEORY OF ELECTRONIC CONDUCTORS AT LOW TEMPERATURES. R.B.Dingle.
Physica, Vol. 22, No. 8, 698-700 (Aug., 1956).

It is shown that the electrical conductivity, thermal conductivity and thermoelectric effects in metals and polar semiconductors can be expressed by formulae which appear as natural extensions of the elementary theory valid for those circumstances for which a "universal" relaxation time can be definied. The formulae involve two formal relaxation times, which coalesce when a universal relaxation time exists. A.

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.1

8177. THE MEAN FREE PATH OF CONDUCTION ELECTRONS IN COPPER. H.Bittel and B.Voss.
Z. Naturforsch., Vol. 11a, No. 5, 419 (May, 1956). In German.

By means of the determination of the temperature coefficient of resistance of copper wires with various diameters down to 1 micron and the use of Matthiessen's rule the mean free path at 20°C is found to be of order 650 to 740 A in good agreement with theoretical prediction. C.A.Hogarth

537.311.3

8178. ELECTRONIC CONDUCTION IN SOLIDS WITH SPHERICALLY SYMMETRIC BAND STRUCTURE. R.Barrie.
Proc. Phys. Soc. B, Vol. 69, Pt 5, 553-61 (May, 1956).

The scattering of electrons whose energy is a function only of the magnitude of their wave-number vector is considered for an elastic and an inelastic process. The elastic process is scattering by ionized impurities, the inelastic is scattering by the non-acoustical modes of the lattice vibrations in a homopolar crystal. The times of relaxation for these two processes are calculated. A.

537.311.33

8179. DEVELOPMENT OF CONCEPTS IN SEMICONDUCTOR RESEARCH. RICHTMYER LECTURE, 1956.
W.H.Brattain.
Amer. J. Phys., Vol. 24, No. 6, 421-5 (Sept., 1956).

537.311.33

8180. THE STOICHIOMETRY OF INTERMETALLIC SEMICONDUCTORS. R.J.Hodgkinson.
J. Electronics, Vol. 1, No. 6, 612-24 (May, 1956).

The effects of small concentrations of point defects on the free energy of a crystal of formula AB are discussed. It is concluded that the maximum melting point of the compound does not occur at the composition corresponding exactly to the formula AB. The type of phase diagram arising from this fact is derived, and its practical consequences discussed. Some experimental evidence, derived from the literature, is quoted to support the conclusions of this paper. In an appendix, it is shown that a crystal which is heat-treated in presence of its vapour will not necessarily have the same concentration of defects as a crystal of the same composition grown from the melt at the same temperature. A.

537.311.33 : 541.57

8181. THE CHEMICAL BOND IN SEMICONDUCTORS.
E.Mooser and W.B.Pearson.
J. Electronics, Vol. 1, No. 6, 629-45 (May, 1956).

A survey of all known semiconductors suggests that it is useful to discuss the existence and properties of a specific "semiconducting bond". A valence bond treatment of semiconductors, because it takes account of the properties of the specific atoms present, furnishes certain results which are not provided by the usual band model treatment. Most important of these are a classification and explanation of the occurrence of intrinsic semiconductivity in known semiconductors and a means of predicting the occurrence of semiconductivity in substances, generally from a consideration only of the chemical formula and valencies of the component atoms. The bonds found in semiconductors are discussed in relation to the bonds found in metallic and ionic conductors and insulators. A.

537.311.33 : 539.11

8182. PICTORIAL KINETIC METHODS IN THE THEORY OF METALS AND SEMICONDUCTORS. R.B.Dingle.
Physica, Vol. 22, No. 8, 671-80 (Aug., 1956).

Two methods have been used in the literature to calculate the electron current in transport problems, the strict Boltzmann method involving the solution of a partial differential equation, and the pictorial kinetic method based on calculations of the average drift velocity in the direction of the applied field. It is shown in the present paper that as customarily formulated this pictorial kinetic method gives erroneous results unless the collision time is independent of the electron speed $|v|$. The fault is traced to an invalid superposition of the additional drift velocity Δv_z, caused (say) by an external electric field E_z, upon the distribution function f_0 in the absence of fields. It is shown that the error may be rectified by replacing, in this context, the ordinary equilibrium distribution function f_0 by a "transport distribution function" $f_t = -v_z \cdot \partial f_0/\partial v_z$. Finally, a method is propounded for finding relations valid for semiconductors by averaging over the transport distribution function the corresponding relations for metals. A.

537.311.33 : 537.311.62 : 535.34

8183. THE ANOMALOUS SKIN EFFECT AND THE OPTICAL ABSORPTIVITY OF SEMICONDUCTORS. I. R.B.Dingle.
Physica, Vol. 22, No. 8, 683-97 (Aug., 1956).

After a brief review of the role played by the anomalous skin effect in the theory of optical absorption by metals, it is shown how the method of averaging over the distribution function, indicated in the preceding abstract, may be applied to derive tentative expressions for optical absorption by semiconductors. A detailed examination of the ways in which the carrier concentration and collision time in semiconductors can be expected to vary with temperature and impurity concentration, is followed by an assessment of the relative importance of the "Drude–Kronig" and "anomalous" terms in the optical absorption under various conditions. It is shown that the anomalous term can be very important in the wavelength range from 300 microns to 1 micron for semiconductors with a fairly large impurity concentration, but is comparatively unimportant for non-degenerate carrier systems unless the effective carrier mass is unusually small. A.

537.311.33 : 536.2.01

8184. THE THEORY OF THERMAL CONDUCTIVITY OF ISOTROPIC SEMICONDUCTORS IN A MAGNETIC FIELD.
O.Madelung.
Z. Naturforsch., Vol. 11a, No. 6, 478-81 (June, 1956). In German.

The electronic contribution to the thermal conductivity decreases as $(\mu_H B)^2$ in low fields and vanishes completely in high fields. In non-degenerate semiconductors the reduction effect is largest in the case of impurity conduction and decreases in importance for intrinsic semiconductors. The effect also decreases with increasing degeneracy. No reference is made to experimental results. E.P.Wohlfarth

537.311.33 : 539.11

8185. THE PROBLEM OF PLASMA OSCILLATIONS AND WAVES IN SEMICONDUCTORS. I. E.Groschwitz and K.Siebertz.
Z. Naturforsch., Vol. 11a, No. 6, 482-91 (June, 1956). In German.

A classical electromagnetic treatment. The dispersion relation, plasma frequency and damping constant are derived as dependent on temperature, impurity content and other parameters of germanium. E.P.Wohlfarth

537.311.33

8186. ON THE QUESTION OF THE RATIONAL DEFINITION OF THE MOBILITY OF THE CURRENT CARRIERS IN SEMICONDUCTORS. T.A.Kontorova.
Zh. tekh. Fiz., Vol. 26, No. 3, 670-3 (1956). In Russian.

Discusses the relation between mobility as defined by $\mu_T = e\bar{\tau}/m^*$ and by $\mu_l = e\bar{l}/m^*\bar{v}$, where a bar indicates that the parameter hs been averaged over the electron distribution. Results are given for the case in which the scattering of the carriers can be described by a mean free path l which is a function of energy, $l(\epsilon) = l_0\epsilon^r$. J.M.Radcliffe

537.311.33 : 535.345

OPTICAL AND ELECTRICAL MEASUREMENTS ON CAESIUM ANTIMONY FILMS OF DIFFERING COMPOSITION.
See Abstr. 7296.

537.311.33

8187. SURFACE CONDUCTIVITY OF COPPER OXIDE.
V.E.Lashkarev and V.I.Lyashenko.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 2, 243-5 (1956). In Russian.

The experiment is designed to make direct observation of the "surface-zone" conductivity as distinct from the conductivity of a sub-surface layer which is really volume conductivity. The surface zone thickness is taken to be equal to the distance in which the Ψ-functions of the surface electrons decay to negligible values. Measurements of the Hall effect and the electrical conductivity were made in vacuum and in an atmosphere of ethyl alcohol vapour. Large differences were found between the "longitudinal" and "transverse" conductivities and activation energies. The longitudinal conductivity is decreased and carrier mobility increased by adsorption of alcohol. Possible causes of this effect are discussed. It is concluded that the surface-zone conductivity in copper oxide has directional character and is associated with a low value of mobility.
J.Adam

537.311.33 : 548.7

8188. THE ELECTRICAL PROPERTIES OF DISLOCATIONS IN GERMANIUM. J.W.Allen.
J. Electronics, Vol. 1, No. 6, 580-8 (May, 1956).

The electron energy levels at an edge dislocation in germanium are discussed. It is shown that these levels will be considerably modified by the presence of a Cottrell impurity atmosphere. This leads to an interpretation of otherwise conflicting experimental results. Further experiments are suggested. A.

537.311.33 : 535.39

8189. USE OF INFRARED ABSORPTION IN GERMANIUM TO DETERMINE CARRIER DISTRIBUTIONS FOR INJECTION AND EXTRACTION. N.J.Harrick.
Phys. Rev., Vol. 103, No. 5, 1173-81 (Sept. 1, 1956).

Measurements of the absorption of infrared radiation by the free carriers in germanium have been used to determine carrier distributions due to injection and extraction. The transverse distributions were found to agree with theory and have been used to determine surface recombination velocity. The longitudinal distributions may be put into four classifications. These are injection field-opposed, injection field-aided, extraction field-opposed and extraction field-aided. Some of these distributions have been studied in detail and have been correlated with the ambipolar carrier transport theory of van Roosbroeck. To do this it was necessary to take into account the change in carrier lifetime with carrier density, which was done according to the Shockley–Read theory. Good agreement was thus obtained between experiment and theory for longitudinal carrier distributions. A.

537.311.33

8190. CARRIER ACCUMULATION IN GERMANIUM. J.B.Arthur, A.F.Gibson and J.B.Gunn.
Proc. Phys. Soc. B, Vol. 69, Pt 7, 697-704 (July, 1956).

Contacts can be made to germanium crystals which are largely impermeable to minority carriers but permeable to majority carriers. In the presence of a suitable electric field high concentrations of minority carriers can accumulate at such contacts. It is the purpose of this paper to describe some experiments which demonstrate the existence of this effect. A.

537.311.33

8191. CURRENT GAIN AT L-H JUNCTIONS IN GERMANIUM. J.B.Arthur, A.F.Gibson and J.B.Gunn.
Proc. Phys. Soc. B, Vol. 69, Pt 7, 705-11 (July, 1956).

Junctions between lightly and heavily doped germanium of the same conductivity type (L-H junctions) have a low leakage velocity for minority carriers. This result, which is discussed in the preceding paper (see preceding abstract), can be considered as a reduction of the minority carrier mobility and gives rise to enhanced current gain in certain structures, for example filamentary transistors. The paper describes experiments designed to demonstrate the existence of this effect and to indicate its magnitude. A.

537.311.33 : 621.314.7

8192. CURRENT GAIN IN FORMED POINT CONTACT N-TYPE GERMANIUM TRANSISTORS. D.Haneman.
Proc. Phys. Soc. B, Vol. 69, Pt 7, 712-20 (July, 1956).

Experiments on germanium point-contact transistors in which collector points of pure donor and acceptor elements are formed show that in general donors appear to be essential to obtain current gain improvements. Successful forming was also achieved with pure gold points. It is assumed that the atoms of the material of the collector diffuse into the germanium during forming. This leads to a change in the amount of lowering of the surface barrier due to the holes injected at the emitter, and accounts for the increased current gain. A.

537.311.33

8193. ON THE INFLUENCE OF HYDROSTATIC PRESSURE ON THE DRIFT MOBILITY OF HOLES IN GERMANIUM. G.Landwehr.
Z. Naturforsch., Vol. 11a, No. 3, 257 (March, 1956). In German.

Careful measurements show that the drift mobility of holes is independent of hydrostatic pressure up to a pressure of 10 000 atmospheres. C.A.Hogarth

537.311.33

8194. THE EFFECT OF IMPURITIES ON THE PROPERTIES OF INDIUM ANTIMONIDE. K.Šmirous.
Czech. J. Phys., Vol. 5, No. 4, 537-44 (Dec., 1955). In Russian with summary (300 words) in English.

A detailed description of the preparation and zone refining of single crystals of p-type InSb from chemically purified In and Sb is given. N-type material was prepared from p-type by alloying with Se. Microphotographs of etched surfaces and measurements of density indicate that any excess In or Sb is precipitated heterogeneously during solidification of the crystal. Doping with elements of group IIb produced p-type material, regardless of the initial type, whereas elements of group VIb resulted in n-type material. Elements from group Ib, as well as In and Sb themselves, failed to change the conductivity type. In all cases, the doping concentration was adjusted to exceed the initial impurity concentration by 2 or 3 orders of magnitude The conductivity type was inferred from the sign of the thermal e.m.f. at low temperatures. J.B.Arthur

537.311.33

8195. EFFECTIVE ELECTRON MASS IN INDIUM ARSENIDE AND INDIUM ANTIMONIDE. R.P.Chasmar and R.Stratton.
Phys. Rev., Vol. 102, No. 6, 1686-7 (June 15, 1956).

Measurements have been made of the Hall coefficient and the thermoelectric power at room temperature and above. The carrier concentrations were $5 \times 10^{16}/cm^3$ extrinsic electrons in InAs and $7 \times 10^{15}/cm^3$ extrinsic holes in InsB. The effective electron mass is plotted as a function of kT. W.Bardsley

537.311.33

8196. ON THE ELECTRICAL PROPERTIES OF MIXED CRYSTALS OF THE FORM $In(As_y P_{1-y})$. H.Weiss.
Z. Naturforsch., Vol. 11a, No. 6, 430-4 (June, 1956). In German.

Hall coefficient and electrical conductivity as functions of temperature were measured on a range of specimens. There is a linear relation between ΔE the forbidden energy gap at absolute zero and y, ΔE varying from 1.35 eV for InP (y = 0) to 0.47 eV for InAs(y = 1). The electron and hole mobilities decrease as composition varies from InAs to InP; the mobility ratio remains large. The temperature dependence of the properties of holes and electrons is of similar form. The carrier effective masses increase monotonically from InAs to InP. C.A.Hogarth

537.311.33

8197. ON THE INCLUSION AND EFFECT OF IMPURITIES IN INDIUM ARSENIDE. E.Schillmann.
Z. Naturforsch., Vol. 11a, No. 6, 463-72 (June, 1956). In German.

The preparation and zone refining of InAs are described. Doping and processing with Mg, Ca, Zn, Cd, Si, Ge, Sn, S, Se and Te was investigated. The conductivity and Hall coefficients of the final specimens were studied, as well as their temperature variations. The segregation constants for the above impurities were measured. Ca is only very slightly soluble in InAs; other Group II and Group IV elements replace In substitutionally and act as acceptors (Group II) or donors (Group IV); Group VI elements replace As substitutionally and act as donors. Measurements from 60 to 1000°K indicate that impurity activation energies are less than 0.005 eV. C.A.Hogarth

537.311.33 : 539.217

8198. THE DIFFUSION OF IMPURITIES IN INDIUM ARSENIDE. E.Schillmann.
Z. Naturforsch., Vol. 11a, No. 6, 472-7 (June, 1956). In German.

Reports results of measurements of the diffusion coefficient of Mg, Zn, Cd, Ge, Sn, S, Se and Te in InAs between 600° and 900°C; the measured values at 900°C lie between 10^{-8} and 10^{-11} $cm^2.sec^{-1}$. The activation energies for diffusion are equal to 1.17 eV, except for S and Se (2.20 eV) and Te (1.28 eV). E.P.Wohlfarth

537.311.33

8199. THE ELECTRICAL PROPERTIES OF InAs. III. D.G.Folberth and H.Weiss.
Z. Naturforsch., Vol. 11a, No. 6, 510-11 (June, 1956). In German.

For Pt II, see Abstr. 3768/1955. Previous papers dealt with strongly doped specimens of InAs. The present studies deal with relatively weakly doped specimens using zinc impurity. P-type specimens with acceptor concentrations less than 2×10^{17}/c.c. show a reversal of Hall coefficient as temperature is decreased but in some cases this is followed by a return to a negative value at lower temperatures. It is shown that the electron mobility rises with increase in specimen purity. G.F.J.Garlick

537.311.33

8200. SPACE-CHARGE FORMATION IN SMALL PbS PARTICLES. H.T.Minden.
J. chem. Phys., Vol. 25, No. 2, 241-8 (Aug., 1956).

A theoretical model is discussed for the effect of oxygen on the electrical properties of PbS thin films. The films are assumed to be composed of very small n-type microcrystals, on the surface of which oxygen is adsorbed. The adsorbed atoms are singly ionized by electrons from the interior of the microcrystals. The appropriate Poisson-Boltzmann equation is solved for particles of radius 5×10^{-8} m, and for donor concentrations of 10^{23} m^{-3} and 10^{24} m^{-3}. The potential distribution is given as a function of the surface acceptor concentration required for the conservation of charge. Models for the electron and hole conductivities are given, and the results of calculations based on these models are compared with experiment. This theory is contrasted with the earlier bulk diffusion theory of the effect of oxygen. The free energy of adsorption is roughly calculated. Implications of this theory are discussed — on the general character of conduction in PbS films, on the temperature coefficient of conduction, and on the nature of photoconduction. A.

537.311.33

8201. THE ELECTRICAL CONDUCTIVITY OF HEXAGONAL SELENIUM. R.A.Hyman.
Proc. Phys. Soc. B, Vol. 69, Pt 7, 743-7 (July, 1956).

A model of selenium is discussed in which it is proposed that a crystal is formed on continuous chains of atoms which zigzag so as to fill a volume which is large compared with the lattice spacing. It is assumed that the charge carriers (holes) move freely along these chains but that transitions between chains are difficult. This predicts the right dependence of conductivity on frequency and a mobility rising with temperature but the magnitude of the resistivity is not explained since this requires a detailed discussion of the transition process. Some related properties are discussed. A.

537.311.33

8202. LINE BROADENING OF AN IMPURITY SPECTRUM IN SILICON. D.Sampson and H.Margenau.
Phys. Rev., Vol. 103, No. 4, 879-86 (Aug. 15, 1956).

Adapting an idea proposed by Fermi to explain the shifts of the high-series lines in the alkali spectra under perturbation by foreign gases, the present paper develops a theory of the broadening of impurity levels in semiconductors. In its principal assumptions it follows the work of Lax and Burstein, but it is simpler and leads perhaps to somewhat better agreement with their own experimental data. While in the problem of the alkalis a large valence orbit is disturbed by the random motion of foreign gas molecules, the same effects result in the present instance from collisions between a hole and the phonons. In detail, the broadening arises from two mechanisms: the scattering of the bound hole by the acoustic motion of the crystal atoms and the fluctuation in polarization energy of the atoms lying between the approximately hydrogen-like orbits of the hole. The former effect is dominant and accounts reasonably well for the experimental results. The calculation is applied to boron-doped silicon and yields a total zero-point broadening of 1.6×10^{-3} electron volts; this is to be compared with an experimental value of about 1×10^{-3} eV and the result of 3×10^{-3} eV obtained by Lax and Burstein. Some question remains about the temperature dependence of the effect. A.

537.311.33

8203. THEORY OF ELECTRON MULTIPLICATION IN SILICON. J.Yamashita.
Progr. theor. Phys., Vol. 15, No. 2, 95-110 (Feb., 1956).

In a previous paper (Abstr. 3722/1955) the conductivity of non-polar crystals in the strong electrostatic field was computed by the kinetic-statistical method. The impact ionization process, however, was neglected there. In the present paper the effect of the impact ionization process is also considered and the theory is extended to the case where the distribution function depends on the velocity and the space-coordinate of the particles. The theory is applied to "the electron multiplication" in the p-n junction of Si, which was observed by McKay and McAfee. A.

537.311.33

8204. RECTIFICATION AND CRYSTAL STRUCTURE. K.R.Dixit.
Indian J. Phys., Vol. 30, No. 1, 10-15 (Jan., 1956).

The work done by Welker on alloy rectifiers, by Hoffmann and Rose and Strosche on the structure of selenium barrier layer, and by the author and his colleagues on the structure of cuprous oxide rectifiers is critically examined. This leads us to expect that a structure like diamond is necessary for an efficient rectifier. A.

537.311.33

8205. ON THE TRANSIENT BEHAVIOR OF SEMICONDUCTOR RECTIFIERS. B.R.Gossick.
J. appl. Phys., Vol. 27, No. 8, 905-11 (Aug., 1956).

The time dependent behaviour of semiconductor surface barrier and point contact diodes has been calculated for small variations. It is assumed that the surface barrier lies on a semiconducting pellet with uniform cross-section. If, on the contrary, the contact area is small compared with the semiconducting surface, like the case considered by Borneman, Schwartz and Stickler (Abstr. 8770/1955), the the analysis given for a point contact applies. It is pointed out that these rectifying barriers have an a.c. admittance of the form

$$Y(j\omega) = G_0(1 - \Gamma) + \Gamma G_0(1 + j\omega\tau)^{1/2} + j\omega C_b$$

in which G_0 is the slope of the d.c. characteristic curve, C_b the barrier capacitance, ω and j the angular frequency and $\sqrt{-1}$, respectively, and τ the recombination time of minority carriers. The dimensionless constant Γ equals the injection ratio γ with surface barriers, but represents $\gamma r_0(L + r_0)^{-1}$ with point contacts where r_0 is the effective contact radius, and L the diffusion length of minority carriers. The constant conductance $G_0(1 - \Gamma)$ is related only to electrons with surface barriers (it is assumed that the semiconductor is n-type and that the rectifying contact emits holes), but with point contacts it is associated with both electrons and holes. The frequency dependent conductance $\Gamma G_0(1 + j\omega\tau)^{1/2}$ is due only to holes in either case. Compared with the conductance $\Gamma G_0(1 + j\omega\tau)^{1/2}$ the barrier capacitance C_b ordinarily plays a more dominant role in the frequency dependence of point contacts than with

surface barriers, because the value of Γ is $r_0(L + r_0)^{-1}$ times its value with surface barriers, and normally $r_0 \ll L$. The barrier voltage response f(t) to an impulse current has been calculated. Although the expression f(t) is complicated, it may be approximated under representative conditions (depending on bias and nature of the contact) by one of the following functions: e^{-t}, $e^{t}\,\mathrm{erfct}^{1/2}$, or $\{[1-2C(t)]\cos t + [1-2S(t)]\sin t\}$ with time t in appropriate units. The functions C(t) and S(t) are the Fresnel integrals defined by the equation

$$C(t) - jS(t) = \int_0^t \frac{e^{-jx}dx}{(2\pi x)^{1/2}} .$$

A special case of large amplitude behaviour, the open circuit voltage decay following the interruption of forward current is also treated. It is found that with surface barriers, the open circuit decay time depends on recombination time of minority carriers, their penetration depth beyond the barrier in the semiconductor, and the injection ratio. With point contacts the decay time depends primarily on the product of the injection ratio and contact radius. A.

537.311.33 : 537.312.5 : 537.531.9

8206. X-RAY PHOTOEFFECT IN GaAs p–n JUNCTIONS. H.Pfister.
Z. Naturforsch., Vol. 11a, No. 6, 434-9 (June, 1956). In German.

The rectification characteristics were measured for GaAs p–n junctions irradiated with X-rays of various intensities and at various temperatures from 0 to 50°C. The dependence of the "photo"-e.m.f. and short circuit current on the X-ray intensity and on the temperature was determined. The e.m.f. is a linear function of intensity for low intensities, a logarithmic function at higher intensities, and decreases linearly with increasing temperature. The short circuit current is a linear function of intensity and independent of temperature. The time constant of the effect is about 2×10^{-3} sec. The application of GaAs junctions as X-ray dosimeters is discussed. C.A.Hogarth

537.311.33

8207. ON THE MODE OF ACTION OF CADMIUM SELENIDE LAYERS IN THE SELENIUM RECTIFIER. II. [FURTHER] CONTRIBUTION. H.Strosche.
Z. Phys., Vol. 145, No. 5, 597-610 (1956). In German.

For Pt I, see Abstr. 6136 (1955). The electrical characteristics of both the cubic and hexagonal forms of CdSe are found to be determined by the quantity of excess Cd present. The additional Cd has more effect in decreasing the resistance for the cubic than for the hexagonal form and in view of the fact that the cubic form can accommodate a greater excess of Cd, the resistance of layers of cubic CdSe will be very much lower than of hexagonal CdSe. It is shown that a double layer of high resistance hexagonal CdSe and low resistance cubic CdSe contributes to the rectification characteristic obtained for the Se, Cd (counter electrode) junction. C.A.Hogarth

537.312.5

8208. ON THE PHOTOELECTRIC PROPERTIES OF CADMIUM SULPHIDE. G.Wlérick.
Ann. Phys. (Paris), Ser. 13, Vol. 1, 623-79 (July-Aug., 1956). In French.

Copper-activated CdS is an n-type semiconductor whose conductivity is strongly photosensitive. When fitted with gold electrodes a CdS layer asymmetrically illuminated shows a large rectification effect. Studies of this effect yield the results: barrier height 0.2 eV, barrier thickness 10^{-4} cm for the barrier CdS-Au, and also a thickness of 10^{-4} cm for the barrier between dark and illuminated portions of the layer. The height of this barrier is measured by the difference in quasi-Fermi levels, as is confirmed by experiments on the variation of the potential of this contact with illumination made on CdS layers maintained in a very high vacuum. The behaviour of CdS photosensitive layers is explained in terms of a trapping model. C.A.Hogarth

537.312.5

8209. THE EFFECT OF TEMPERATURE ON THE PHOTOCONDUCTIVITY OF POLYCRYSTALLINE PLATES OF HgI_2. D.V.Chepur and O.A.Red'ka.
Zh. tekh. Fiz., Vol. 26, No. 3, 553-9 (1956). In Russian.

Thin plates of red HgI_2 showed a dark resistivity $>10^{13}$ ohm.cm at room temperature, with a thermal activation energy of 1.4 eV. Marked photoconductivity was observed, a change in conductivity by a factor $>10^5$ being obtainable. Response fell off above 100 c/s. Fatigue effects were observed on prolonged illumination. The spectral response showed a maximum near 590 mμ and suggested a second at a much shorter wavelength. The long wavelength cut-off was near 650 mμ. Below 50°C the response varied little with temperature, but it increased markedly near 125°C, then dropped to zero when red HgI_2 transformed to yellow. Curves of dark current vs. voltage and photocurrent vs. radiation intensity were obtained for various temperatures. The lifetime and mobility of the photocurrent carriers were studied by measurements of, respectively, the decay of photoconductivity and the Hall effect. C.H.L.Goodman

537.312.6

8210. POSSIBLE APPROACH TO THE LOW-TEMPERATURE RESISTANCE MAXIMUM IN DILUTE ALLOYS OF TRANSITION METALS IN NOBLE METALS. R.W.Schmitt.
Phys. Rev., Vol. 103, No. 1, 83-7 (July 1, 1956).

If a dilute alloy of a transition metal in a noble metal becomes ferromagnetic, the spin degeneracy of the ground state of the impurity atom is removed by the local field. Scattering of the conduction electrons by the impurity atoms can then take place by inelastic as well as elastic collisions. Assuming the scattering cross-section for elastic scattering is larger for the lower lying nondegenerate states, one gets the following results: (1) There is a maximum in the temperature-dependent resistivity. (2) The temperature at which the maximum occurs varies rapidly with concentration of the transition metal. (3) The magnetoresistance is negative up to some temperature higher than the temperature at which the maximum in resistivity occurs. The experimental observations of Gerritsen and Linde and of Gerritsen on the resistivity of these alloys are, for the most part, in qualitative agreement with these consequences. This model does not require the existence of localized electronic states with energy near the Fermi energy as does the model presented by Korringa and Gerritsen. A.

537.312.62

8211. THE PENETRATION DEPTH IN IMPURE SUPERCONDUCTING TIN. R.G.Chambers.
Proc. Cambridge Phil. Soc., Vol. 52, Pt 2, 363-75 (1956).

A new method is described for measuring the surface impedance of metals at low temperatures and at radio-frequencies. Using this method, the surface impedance of normal tin and the penetration depth λ in superconducting tin have been studied at about 9 Mc/s frequency as a function of impurity content. The measured surface impedances agree well with the values expected, and the penetration depths increase with impurity content, in confirmation of Pippard's observations (1953) at 9400 Mc/s. The variation of λ with reduced temperature t is well represented by the equation $\lambda/\lambda_0 = (1 - t^4)^{-1.2}$, in impure as well as in pure tin. The absolute value of λ_0 found for pure tin is about 4×10^{-6} cm significantly lower than the values previously found. A.

537.312.62

8212. SUPERCONDUCTIVITY IN THE NIOBIUM–NITROGEN SYSTEM. G.Lautz and E.Schröder.
Z. Naturforsch., Vol. 11a, No. 6, 518-20 (June, 1956). In German.

Reports measurements on the magnetic transition in Nb–N powders of varying composition, in a field of 145 G. The transitions were spread over 3-4°K and showed considerable hysteresis, except that for pure Nb, which showed

no hysteresis and occupied 8.6-9.4°K. The hysteresis was not found in powders containing oxygen impurity.
R.G.Chambers

537.312.7

8213. DARK CONDUCTIVITY OF SILVER BROMIDE CRYSTALS. V.V.Gladkovskiĭ and P.V.Meĭklyar.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 833-9 (1956). In Russian.

It is shown that in large silver halide crystals the conductivity in weak fields is of an electronic nature. In strong fields the ions begin to move over the crystal imperfections and on the surface and an accompanying growth of the dendrites is observed. On brief illumination the crystal conductivity first increases and then decreases. The effect of brief illumination depends on the medium in which the crystal is located. A.

537.312.8

8214. CONDUCTIVITY OF FILMS IN A LONGITUDINAL MAGNETIC FIELD. M.Ya.Azbel'.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 4, 519-22 (1954). In Russian.

Expressions are derived for the electronic distribution function in a metallic film in a constant magnetic field parallel to the surface of the film. Formulae are derived for the effective conductivity valid for all the coefficients of reflection of electrons from the surface. The value of zero for the coefficient is considered in detail since the result is physically significant. The dependence of the conductivity on the magnetic film is plotted and analysed for different film thicknesses.
Mathematical Reviews

537.321

8215. THE ELECTROMOTIVE FORCES OF THERMO-CIRCUITS WITH MOLTEN SALTS. B.F.Markov.
Dokl. Akad. Nauk SSSR, Vol. 108, No. 1, 115-17 (1956). In Russian.

These were measured for molten silver halides by themselves as well as mixed with those of alkali metals. The sequence of e.m.f.'s reverses that of solid salts, i.e. it decreases from AgI to AgBr to AgCl. Following Wagner the heterogeneous effect is estimated thermodynamically. For this it suffices to determine the entropy of silver and the molten silver halides at the experimental temperature. The homogeneous effect decreases similarly to the solid case, from AgCl to AgBr to AgI; the absolute temperature coefficients decrease in the same sequence. J.Jacobs

537.324

8216. ON INCREASING THE EFFICIENCY OF SEMICONDUCTING THERMOCOUPLES. A.F.Ioffe, S.V.Airapetyants, A.V.Ioffe, N.V.Kolomoets and L.S.Stil'bans.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 6, 981 (1956). In Russian.

Consideration of semiconductors in thermo-electric generators and refrigerators leads to three requirements: (1) discovery of materials with a high ratio of electrical carrier mobility to lattice thermal conductivity, (2) carrier concentrations which will result in the optimum thermal e.m.f. of ±200 μV/degree, (3) further increasing the above ratio in these materials. This might be done by making a binary material using a second element as an impurity which crystallizes in the same system as the first in such a way that the electrical mobility is little affected but the thermal conductivity is reduced. W.Bardsley

537.36

8217. OBSERVATION OF ELECTROCONDUCTIVE CONVECTION IN ELECTROLYTES. G.A.Ostroumov.
Zh. éksper. teor. Fiz., Vol. 29, No. 4 (10), 529-32 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 3, 428-32 (May, 1956).

Several series of experiments of qualitative character were carried out to clarify spontaneous movement in distilled water, the electroconductivity of which is increased in some places by addition of a dyed electrolyte. The experiments substantiated the assumed properties of the phenomenon, in particular, it was possible to produce a model of the phenomenon of corona discharge from a point. Fluctuating characteristics were noted. A.

537.376

8218. VOLTAGE DISTRIBUTION INSIDE ELECTROLUMINESCENT ZnS CRYSTALS. G.Diemer and P.Zalm.
Physica, Vol. 22, No. 6, 561-2 (June, 1956).

A theoretical analysis is made of the voltage distribution in an electroluminescent layer after build up of localized potential barriers has reached equilibrium. It is shown that at the local barrier the field strength is 10x the average applied field strength. An explanation of the small electroluminescence efficiencies for the layers is provided. G.F.J.Garlick

ELECTRIC DISCHARGES 537.52

537.521.7

8219. UNIFORM-FIELD BREAKDOWN IN AIR. R.F.Saxe.
Brit. J. appl. Phys., Vol. 7, No. 9, 336-40 (Sept., 1956).

Experiments on the breakdown processes in a uniform-field gap at the minimum d.c. breakdown voltage in air at atmospheric pressure are described. It is shown that the breakdown processes consist of two phases, (1) a diffuse glow completely bridging the gap, followed by (2) a filamentary channel moving from the cathode to the anode, and bridging a 0.77 cm gap in about 3×10^{-9} sec in a 13 ohm coaxial system. Spectrograms of the stages of the discharge are also given. These experimental results are in disagreement with both the Townsend and the Streamer theories. A.

537.521.7

8220. THE ORIGIN OF STREAMERS IN SPARK DISCHARGES. G.Francis and A. von Engel.
Z. Phys., Vol. 145, No. 5, 560-2 (1956).

A theoretical attempt to account for the well-known results of observations on luminous channels in long sparks in terms of two-stage process of ionization of excited atoms by electron collision. J.Dutton

537.523.5

8221. A CYLINDRICAL ARC FOR HIGH LOADING. H.Maecker.
Z. Naturforsch., Vol. 11a, No. 6, 457-9 (June, 1956). In German.

Describes an experimental arrangement for running high-current (~ 100 A) arcs through a series of water cooled insulated copper discs with axial apertures. Loadings may be ~ 10 kW/cm of arc length. A photograph is shown of such an arc in operation. J.D.Craggs

537.523.5

8222. THE DETERMINATION OF THE TEMPERATURE OF ARCS BY [PHOTOGRAPHIC] BLACKENING COMPARISON WITH A SIMILAR ARC OF KNOWN TEMPERATURE DISTRIBUTION. G.Busz-Peuckert and H.J.Queisser.
Z. Naturforsch., Vol. 11a, No. 6, 512-13 (June, 1956). In German.

Describes a photographic technique, involving quantitative calibration of photographic emulsions, for measuring arc temperatures. High current (100-500 A) argon arcs are specifically treated. A standard arc, whose temperature and spatial variations thereof are known, is used. The standard arc temperatures may be measured spectroscopically or by X-ray absorption etc. J.D.Craggs

537.525 : 538.561

8223. ON THE THEORY OF WAVE MOTION OF AN ELECTRON PLASMA. A.J.Akhiezer and R.V.Polovin.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 915-28 (1956). In Russian.

A general investigation of non-linear wave motion of an electron plasma for arbitrary electron velocities has been carried out. Temperature effects were not taken into account and the state of the plasma was described by the particle density instead of a distribution function. A correspondence between the plasma wave motion and the motion of a non-relativistic particle in a potential field has been established. The dependence of the frequency of the longitudinal oscillations on the amplitude of the velocity has been determined. Non-linear transverse plasma oscillations and those similar to them were also examined and their frequencies have been determined. A number of relations for complex coupled transverse-longitudinal plasma oscillations have been established. A.

537.525.6

8224. THE DISCHARGE MECHANISM IN THE HIGH-VACUUM COLD-CATHODE PULSED X-RAY TUBE.
P.T.G.Flynn.
Proc. Phys. Soc. B, Vol. 69, Pt 7, 748-62 (July, 1956).

The existing theory of the discharge mechanism in the cold-cathode pulsed X-ray tube based on ionization of residual gas and plasma formation is reviewed and is shown to fail for a high-vacuum tube. A new theory is presented which is based on the production at the cathode of a vapour jet having a velocity of approximately 10^6 cm sec^{-1}. This results in an expanding region of low voltage discharge, and leaves most of the applied voltage across a rapidly contracting vacuum region adjacent to the anode. It is shown that the tube current and voltage as functions of time and the X-ray pulse duration can be predicted from a knowledge of the voltage supply and tube parameters, and the results are verified experimentally. A.

537.527.5

8225. THE PRESSURE IN XENON HIGH-PRESSURE DISCHARGES. E.Palm.
Ann. Phys. (Leipzig)., Vol. 18, No. 1-2, 17-28 (1956). In German.

Describes measurements of the pressure in discharge chambers containing xenon arcs running at 0-10 A. Pressures varying up to about 60 atmospheres were involved. Pressure measurements were made with a delicate quartz Bourdon gauge. The results are discussed in terms of arc characteristics (wattage dissipation etc.). J.D.Craggs

X-RAYS 537.531

537.531 : 535.33 : 531.717.1

FILM THICKNESS BY X-RAY EMISSION SPECTROGRAPHY. See Abstr. 7171

537.531 : 535.33.07

8226. RESPONSE OF A SODIUM-IODIDE SCINTILLATION SPECTROMETER TO 10- TO 20-MILLION-ELECTRON-VOLT ELECTRONS AND X-RAYS. H.W.Koch and J.M.Wyckoff.
J. Res. Nat. Bur. Stand., Vol. 56, No. 6, 319-26 (June, 1956).

The response of a large-crystal NaI spectrometer was studied for individual monoenergetic electrons extracted from a 50 MeV betatron operated between 1 and 20 MeV. The energy resolution with crystals 5 in. diameter by 4 in. in length and 5 in. diameter by 9 in. in length reaches its optimum value for electrons of 6 MeV, where the total width of the pulse-height distribution at half maximum is 4%. Syntheses of pulse-height distributions for 11 and 19 MeV monoenergetic X-ray photons are made by using the experimental electron pulse-height distributions. The computed results compare favourably with the measured pulse-height distributions for 11.6 and 17.6 MeV gamma-rays. Syntheses provide one of the few procedures for predicting spectrometer response functions in this X-ray energy range. A.

537.531.85 : 539.166.74

8227. SUMMARY OF RECENT MEASUREMENTS OF THE COMPTON EFFECT. A.Bernstein and A.K.Mann.
Amer. J. Phys., Vol. 24, No. 6, 445-50 (Sept., 1956).

The use of newly developed experimental techniques has led to the performance of experiments that have verified with relatively high precision both the assumptions and predictions of the quantum theory of the Compton effect. Several of these recent experiments, including some on the simultaneity of appearance of the scattered photon and recoil electron, the conservation of energy and momentum and the differential and total scattering cross sections, are briefly described. Their results are compared with those of earlier experiments and with theory to indicate the degree of severity with which the theory is presently tested. A.

CATHODE RAYS. POSITIVE RAYS 537.533/534

537.533

8228. INSTABILITY IN HOLLOW AND STRIP ELECTRON BEAMS. C.C.Cutler.
J. appl. Phys., Vol. 27, No. 9, 1028-9 (Sept., 1956).

A thin strip or hollow electron beam drifting in a magnetic field directed parallel to the direction of motion is in an unstable condition. As a result of initial nonuniformities the beam breaks up into a series of "spiral nebulae". Some experimental observations are described which are of help in understanding the phenomenon, and it is shown that it can be applied to give useful amplification. A.

537.533

8229. ON THE INFLUENCE OF QUANTUM FLUCTUATIONS ON THE PATH OF ELECTRONS IN A MAGNETIC FIELD.
A.A.Kolomenskiĭ and A.N.Lebedev.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 205-7 (1956). In Russian.

Quantum characteristics become important when the energy is greater than about 10^{15} eV and above this quanta of radiation are emitted. The effect of this on the path of an electron is discussed mathematically. J.M.Hough

537.533

8230. ON THE INFLUENCE OF RADIATION IN THE MOVEMENT OF RELATIVISTIC ELECTRONS IN A MAGNETIC FIELD. A.A.Kolomenskiĭ and A.N.Lebedev.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 5, 807-10 (1956). In Russian.

Discusses the effect of electrons emitting photons on the action of the betatron. See also preceding abstract.

J.M.Hough

537.533.3

8231. EXTENSION OF THE ELECTRON-OPTICAL THEORY OF DEFLECTING ELECTROSTATIC SYSTEMS TO THE CASE OF RELATIVISTIC PARTICLES. A.M.Strashkevich.
Zh. tekh. Fiz., Vol. 24, No. 12, 2264-70 (1954). In Russian.

The systems considered have two perpendicular planes of symmetry. The field is symmetrical with respect to one plane, and antisymmetrical with respect to the other. The trajectories of fast paraxial electrons are determined from relativistic equations of motion. The results are carried out to the second order of approximation. The deflection sensitivity is determined. It is higher than in the non-relativistic case. Two cases are given as illustrations: the parallel

plate condenser, and the system of two electrodes in the same plane. End effects are disregarded for entering as well as for emerging electrons. The results are intended for application, e.g. to cathode-ray tube design, but their usefulness is restricted because of end effects on entering electrons.
Mathematical Reviews

537.533.3 : 535.8

THE LIGHT GATHERING POWER OF OPTICAL SYSTEMS WITH AN ELECTRON OPTICAL MEMBER. See Abstr. 7335

537.533.331

8232. FOCAL PROPERTIES AND CHROMATIC AND SPHERICAL ABERRATIONS OF THE THREE-ELECTRODE ELECTRON LENS. G.D.Archard.
Brit. J. appl. Phys., Vol. 7, No. 9, 330-2 (Sept., 1956).

Published theoretical and experimental values of the focal length of simple three-electrode electron lenses are compared and found to be in general agreement. These are presented in the form of graphs which show directly the dependence of focal length on lens geometry and voltage ratio. Analogous graphs are derived for spherical and chromatic aberrations in the form of the ratios C_S/S and C_C/S (S being the separation of adjacent electrodes), and the general relation between the various curves is discussed. A.

537.533.335

8233. PRACTICAL REALIZATION OF A QUADRUPLE MAGNETIC LENS FOR HIGH-ENERGY PARTICLES. A.Septier.
C.R. Acad. Sci. (Paris), Vol. 243, No. 2, 132-5 (July 9, 1956). In French.

A magnetic quadruple lens is formed from four polepieces having rounded tips so designed as to approximate the hyperbolic cross-section demanded by theory. Measurements by search-coil (presented graphically) show that the theoretical distribution of the transverse field is closely approached.
A.E.I. Research Laboratory

537.533.35

8234. SHAPE OF OBJECTIVE APERTURE, ASTIGMATISM AND RESOLUTION OF THE ELECTRON MICROSCOPE. T.Hibi and S.Takahashi.
Rev. sci. Instrum., Vol. 27, No. 7, 542 (July, 1956).

Image quality depends on the shape of the objective aperture. Higher degrees of resolution, with lower astigmatism, are obtained as the apertures become more perfectly circular.
R.Reed

537.533.8

8235. THE X-RAY SPECTRUM FROM A 30 MeV BETATRON. E.Hisdal and J.P.Roalsvig.
Arch. Math. Naturvid., Vol. 53, No. 4, 10 pp. (1956).

Describes measurements of the bremsstrahlung spectrum of 30 MeV electrons striking a platinum target. The spectrum is measured with the aid of nuclear photographic emulsions. Pairs of negatrons and positrons were produced in the nuclear plates by the X-rays, and the energy of the pairs was determined by multiple scattering measurements. The values of the cross-section for pair production from Bethe and Heitler's theory were used together with the scattering measurements to determine the approximate X-ray spectrum in the region from 4-30 MeV. A.

537.533.9

8236. ENERGY LOSS AND RANGE OF ELECTRONS AND POSITRONS. A.T.Nelms.
Circ. Nat. Bur. Stand., No. 577, 1-30 (1956).

Tabulations of the mean energy loss due to ionization and excitation and the range derived from this quantity are given for electrons and positrons in various materials. A.

537.533.9

8237. ANOTHER CONTRIBUTION TO THE DISCUSSION ON THE QUANTUM THEORY OF RADIATING ELECTRONS. A.A.Sokolov.
Zh. éksper. teor. Fiz.,Vol. 30, No. 3, 623 (1956). In Russian.

The author's theory (Abstr. 8349/1954) was criticised by Nelipa (Abstr. 1909/1955). In the present reply it is pointed out that the criticism is based on incorrect quotations from the original work. R.Eisenschitz

537.534.3

8238. MASS SPECTROMETER RESEARCHES. G.P.Barnard.
London: Her Majesty's Stationery Office (1956) 62 pp. (Department of Scientific and Industrial Research - N.P.L.).

A detailed description is given of the design and construction of a first-order focusing, 60°, precision instrument for comparison of different electron-bombardment ion source arrangements. Facilities were included for adjustment of spectrometer and pole pieces to compensate for fringing fields, and observations on the integrated effects of fringing flux were carried out. Behaviour of electron bombardment ion sources is reviewed and discussed with special reference to the effects of magnetic field in the source region. Experimental sources were constructed, using trochoidal electron beams, to obtain well collimated beams over a range of magnetic field strengths; details of construction and operation are given; disturbances from secondary electron emission were greatly reduced. Studies of dependence of ionic transmission on source conditions were carried out, mainly using Ne^{20} for a low source field (~ 25 gauss). It is concluded that a substantial source field (estimated 200 gauss) is essential to control of the ion beam, leading to improved resolution and sensitivity, and to reduced voltage effects. The evidence suggests that the 180° instrument is superior to the sector field; the best features of the two types are a large source magnetic field independent of the main analyser field, and magnetic scanning with fixed potential arrangements; it is suggested that a spectrometer combining these characteristics would be advantageous. N.M.King

537.534.3

8239. MASS SYNCHROMETER. L.G.Smith and C.C.Damm.
Rev. sci. Instrum., Vol. 27, No. 8, 638-49 (Aug., 1956).

A novel mass spectrometer with which masses of ions are determined in terms of high harmonics of their cyclotron frequencies is described from both experimental and theoretical viewpoints. Half-width resolution is adjustable electrically over a range of values presently between 10 000 and 25 000 at all mass numbers below 250. By means of highly precise technique of matching peaks, relative doublet separations in frequency ($\Delta f/f$) exactly equal to those in mass ($\Delta M/M$) are determined with great ease and accuracy on a ratio scaler. Masses have been determined with an accuracy of better than one part in 10^7, which is comparable with the best yielded by conventional instruments. Measurements should be of particular importance, even if of no greater precision than others, because the very different techniques employed make unlikely the occurrence of unsuspected systematic errors of the same nature as in other work. Sources of systematic error are discussed. It is believed that most of these have been eliminated, though avoidance of the not uncommon errors caused by differences in orbit distributions in doublets involving ions formed by dissociation has so far led to such large reductions of intensity as to restrict greatly the number of such important doublets for which reliable data have been obtainable. The synchrometer is apparently at a disadvantage to some deflection-type spectrometers in the matter of intensity, to some extent in principle and to a greater extent (to date) in practice. This disadvantage is enhanced by the difficulties of using an electron multiplier for detecting ions in strong magnetic fields. It is believed that the latter difficulties are not insuperable and it seems reasonable to expect the further work on increas-

ing the intensity and improving the focusing of ions from the source will greatly enhance the number of results obtained. The possibilities of using the instrument for analytical purposes are interesting but so far largely unexplored. A.

537.534.7

8240. THE RADIOFREQUENCY MASS SPECTROMETER AS AN ANALOGUE TO THE OPTICAL GRATING. I.Cornides.
Acta phys. Hungar., Vol. 5, No. 4, 471-82 (1956).

The r.f. spectrometer of the Bennett type (Abstr. 2503/1950) is, according to the theory outlined, a strict analogue to a nonequidistant optical grating, and, due to this fact, its problems may be treated by applying the corresponding optical considerations and formulae. The complication caused by the varying grating constant is overcome with the aid of a simple mechanism, which gives complete graphical information about the energy gain function, making thus possible the proper choice of Bennett's empirically chosen combination for the numbers of cycles. Redhead's analyser (Abstr. 3366/1953) is a simple special equidistant spectrometer, its formulae may, of course, be easily derived from the formulae of the optical grating. It is found, however, that a Bennett type analyser with properly spaced stages exhibits much better resolutions, than a Redhead type with the same number of stages. A.

537.534.74

8241. POLARISATION IN p–p SCATTERING.
C.C.Banerjee.
Indian J. Phys., Vol. 30, No. 6, 292-8 (June, 1956).

Attempts to investigate the polarization and asymmetry in proton–proton scattering with the assumption that the particles obey the Dirac equation. The results obtained explain qualitatively the main aspects of experimental observations. A.

537.534.74

8242. ANALYSIS OF PROTON–PROTON SCATTERING DATA AT 300 MeV. M.H.Hull, Jr, J.B.Ehrman, R.D.Hatcher and L.Durand.
Phys. Rev., Vol. 103, No. 4, 1047-52 (Aug. 15, 1956).

An analysis of proton–proton scattering experiments is described and some results for 300 MeV are presented. Phase shifts for states with $J \leq 4$ are included, and effects of states of higher angular momentum are discussed. The importance of including Coulomb interference effects is brought out. A.

537.534.74 : 539.185

8243. POLARISATION OF HIGH ENERGY NUCLEONS SCATTERED BY NUCLEI. H.S.Köhler.
Nuclear Physics, Vol. 1, No. 6, 433-44 (May, 1956).

Calculations have been made on the polarization of protons scattered by nuclei at 135 and around 300 MeV. With a spin–orbit coupling similar to that used by E.Fermi good agreement with experiments made at Harwell and Berkeley is obtained for medium and heavy elements, while not for the lightest. An explicit formula for the polarization of neutrons is derived in certain approximations and discussed. A.

537.534.75 : 778.34

8244. RANGE–ENERGY RELATIONS FOR IONS $3 \leq Z \leq 10$ IN ILFORD C.2. EMULSIONS. A.Papineau.
C.R. Acad. Sci. (Paris), Vol. 242, No. 25, 2933-6 (June 18, 1956). In French.

Experimental results on the charge states of nitrogen, oxygen and neon ions as a function of velocity have been used to calculate range–energy curves for various heavy ions in Ilford C.2. emulsion from the known curve for α-particles. Agreement with rather meagre experimental results is quite good. D.J.Prowse

537.534.75

8245. RANGE VELOCITY RELATIONSHIP FOR ^{7}Li IONS IN SOLIDS. S.Devons and J.H.Towle.
Proc. Phys. Soc. A, Vol. 69, Pt 4, 345-7 (April, 1956).

The $Be^9(d, \alpha)Li^7$ reaction at a deuteron energy of 1 MeV was used to produce Li^7 ions of velocity (V_0) 8.6×10^8 cm.sec^{-1}. These were slowed down in foils of Al, Cu and Au and the velocities of the transmitted ions were measured magnetically. A range–velocity relationship is given for velocities down to about 0.6 V_0. M.A.Grace

537.534.8

8246. CONSIDERATION OF THE EFFECT OF NON-CENTRAL FORCES ON BREMSSTRAHLUNG IN NEUTRON–PROTON COLLISIONS. B.L.Timan.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 881-3 (1956). In Russian.

The bremsstrahlung differential cross-section for colliding high energy nucleons has been computed with account of non-central forces. A

DISCHARGE TUBES. COUNTERS 537.54

537.542

8247. CONTROL AND MEASUREMENT OF AN ION SOURCE OF A PRESSURE INSULATED VAN DE GRAAFF GENERATOR. A.G.de Boer, J.Kley and J.H.Makkink.
Rev. sci. Instrum., Vol. 27, No. 8, 614-18 (Aug., 1956).

A very simple method has been developed for the control and measurement of an ion source in the top terminal of a high pressure insulated Van de Graaff generator. The sending and receiving of information from the outside of the tank to the high voltage (h.v.) electrode is achieved by means of light signals. A

537.542

8248. THE RETARDING POTENTIAL AS A STABILIZING FACTOR FOR THE WORKING CONDITIONS OF ALUMINIUM G-M COUNTERS. B.Sujak.
Acta phys. Polon., Vol. 14, No. 6, 489-91 (1951).

The spurious counts often obtained with easily oxidized cathode metals (e.g. Al) can be reduced, it is shown, by the use of a grid placed near the cathode. Counter characteristics for different grid potentials etc., are shown. J.D.Craggs

537.542

8249. THE TEMPERATURE-DEPENDENCE OF G-M. COUNTER CHARACTERISTICS. I. S.P.Puri and P.S.Gill.
Indian J. Phys., Vol. 30, No. 2, 62-9 (Feb., 1956).

A study of the characteristics of a self-quenching argon–petroleum ether internal, and an argon–alcohol filled external counter was carried out in the range of 16° C to –20° C. The internal counter is found to be independent of temperature in the above mentioned range of temperature. The changes of the characteristics of the argon–alcohol filled external cathode counter are ascribed to the condensation of the alcohol content. This counter is temperature-independent up to –7° C. The threshold voltage falls by about 100 volts at –11.5° C and decreases by further lowering the temperature. The operation remains the same down to a few degrees lower than the saturation temperature. Beyond –11.5° C the electrical resistance of the glass envelope becomes too high to allow this type of counter to operate satisfactorily. A.

537.542

8250. THE TEMPERATURE-DEPENDENCES OF G-M. COUNTER CHARACTERISTICS. II. S.P.Puri and P.S.Gill.
Indian J. Phys., Vol. 30, No. 2, 70-9 (Feb., 1956).

The measurements were made on self-quenching argon–petroleum ether, argon–butane, and argon–alcohol filled G.-M. counters in the range of 32° to 150° C, 34° to 100° C and 27° to 138° C respectively. The results of the present investigation indicate the following: (i) There is a progressive rise of the threshold as the temperature is increased. (ii) The

bove mentioned three counters seem to be substantially temerature-independent, up to 80° C, 55° C and 105° C respectively. (iii) There is an exponential increase in slope with temperature and decrease in overall width of the plateau characteristics at higher temperatures. (iv) A large increase in counting rate is experienced at higher temperatures. However, here is increase only in frequency and not in multiplicity. v) There is a sudden deterioration of these counters at 100° C, 5° C and 105° C respectively. It is inferred that it is the esorption of the quenching vapour at higher temperatures, hich causes the rise of the threshold. The increase in counting rate with temperature may be due to the formation of egative ions of the absorbed gas at the cathode. A.

537.542

8251. ANALYSIS OF SPURIOUSNESS OF GEIGER-MULLER TUBES AT HIGH TEMPERATURES. S.P.Puri and P.S.Gill. ndian J. Phys., Vol. 30, No. 1, 1-9 (Jan., 1956).

A quantitative confirmation of the conclusions reported in he preceding abstracts is obtained by studying the time-listribution of pulses at higher temperatures by the method of lelayed coincidence. The results of the present investigation ndicate that: (i) The dead and transit times remain constant vith temperature. (ii) The coefficient of secondary emission emains constant in the case of internal counters, whereas here is an exponential increase in its value in the case of Maze ype of counter. (iii) The high counting rate decays with the ime of heating and the curve is analogous to that of the desorption of the quenching vapour. These observations are discussed in light of possible mechanisms and it is inferred that desorption of the vapour at high temperatures is the cause of emperature effect. The mechanism of emission of the adsorbed vapour is not clear. A.

537.542 : 539.172.4 : 621.387.422

8252. NUCLEAR-REACTION-CONTROL IONIZATION CHAMBERS. W.Abson and F.Wade. Proc. Instn Elect. Engrs, Paper 2029 M, publ. March, 1956 (Vol. 103 B, 590-6, 607-15).

Republication, with discussion, of the paper abstracted in Abstr. 2959 (1956).

537.542

8253. RESPONSE FUNCTION OF THALLIUM-ACTIVATED SODIUM-IODIDE SCINTILLATION COUNTERS. M.J.Berger and J.Doggett. J. Res. Nat. Bur. Stand., Vol. 56, No. 6, 355-66 (June, 1956).

Measurements of gamma-rays with NaI(Tl) crystals yield pulse-height distributions related to the true energy spectrum by an integral equation whose kernel (response function) is the probability that an incident photon of energy E will give rise to a pulse of size E'. The response function has been calculated by the Monte Carlo method for photons with energies from 0.279 to 4.45 MeV. Results are presented for cylindrical crystals ranging in size from 0.25 (radius) by 0.5 in. (length) to 2.5 by 9 in. They are based on the analysis of 50 000 photon histories sampled with the use of the SEAC computer. Analytical corrections were made for the escape of annihilation radiation and bremsstrahlung from the crystal. A.

537.542 : 535.376

8254. SCINTILLATION RESPONSE OF ANTHRACENE TO 6-30 keV PHOTOELECTRONS. J.B.Birks and F.D.Brooks. Proc. Phys. Soc. B, Vol. 69, Pt 7, 721-30 (July, 1956).

Observations have been made of the scintillation response S of a 0.2 cm thick anthracene crystal to photoelectrons of energy E = 6 to 30 keV produced by various characteristic K K-rays. The responses to In^{114} and Cs^{137} internal conversion electrons were also measured, and the results reduced to a standard scale of S, and compared with other data. The (S, E) curve agrees closely with that predicted theoretically. The response curve at −65° C is identical with that at 16° C, apart from a general increase of 50% in S. The response to internal electrons is significantly greater than that to external electrons of the same low energy. Reasons are suggested for the divergent results reported by Robinson and Jentschke. The reduced response to external electrons is attributed to the escape and/or quenching of the fluorescence excitation energy at the crystal surface. These and other surface phenomena affecting the response of organic scintillators to short-range external particles are discussed. A.

537.542

8255. NONLINEAR RESPONSE OF NaI(Tl) TO PHOTONS. D.Engelkemeir. Rev. sci. Instrum., Vol. 27, No. 8, 589-91 (Aug., 1956).

A study of the response of the sodium iodide scintillation counter to photons in the energy range from 10 to 1500 keV has shown the presence of a significant nonlinearity. Response curves are given for a number of crystals of different dimensions. A.

537.542 : 621.317.39

8256. TIME-TO-PULSE-HEIGHT CONVERTER FOR MEASUREMENT OF MILLIMICROSECOND TIME INTERVALS. W.Weber, C.W.Johnstone and L.Cranberg. Rev. sci. Instrum., Vol. 27, No. 3, 165-70 (March, 1956).

A circuit is described which is designed to measure the time elapsed between a fast-rising signal from a nuclear detector and the next pulse from a steady source of pulses which are evenly spaced in time and occur at an r.f. rate. This circuit has been found useful for measuring time intervals in the millimicrosecond range as part of a system of fast-neutron spectrometry which utilizes a pulsed source of neutrons. The conversion of time to pulse height is linear for time intervals from 10 mμsec to a time which is 20 mμsec shorter than the interval between the r.f. pulses. The resolution obtainable depends on the characteristics of the detector. The precision of time measurement is about 1 mμsec. A.

537.542

8257. TEMPERATURE CHANGES AND CONDENSATION DURING ADIABATIC EXPANSIONS OF AIR SATURATED WITH VAPOUR. D.Stachórska. Acta phys. Polon., Vol. 15, No. 1, 5-24 (1956).

The aim of this work was to measure temperature changes occurring during expansion in a Wilson chamber. A resistance thermometer was used in a Wheatstone bridge system in which a cathode ray oscilloscope served as an indicator. Measurements were performed either in the presence of a powerful ionizing substance, or without this substance, but in the presence of a field which removed the ions. In both cases diagrams of the dependence of the temperature decrease ΔT on the ratio of final and initial volumes v_2/v_1 were obtained. The limit of condensation is indicated in these curves by an abrupt change of the slope. When the ratio v_2/v_1 crosses the critical expansion ratio (the limit of condensation) the character of the oscillogram is radically changed. There appears a steep section corresponding to the emitted heat of condensation. The final point of this section determines the equilibrium temperature T. This experimental value is in good agreement with that calculated on theoretical basis. If the steep section in the oscillogram is taken as a criterion of condensation, then from the measured values the limit of condensation on ions and on neutral aggregates may be calculated. The values obtained in this way for alcohol vapour, namely 1.150 and 1.180, are in agreement with those found by other authors by means of direct observation. From the inclination of this steep section the time of the condensation could be estimated to be about 0.02 sec for the expansion $v_2/v_1 = 1.170$ in the presence of an ionizing sample. A.

537.542

8258. ON n-PENTANE BUBBLE CHAMBERS. P.Bassi, A.Loria, J.A.Meyer, P.Mittner and I.Scotoni. Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 491-500 (Aug., 1956).

Both a clean and a dirty n-pentane bubble chamber have been operated. A description is given together with the results

of an investigation into the influence which working conditions have on the sensitive time, and the size and number of the bubbles produced along the tracks. The number of bubbles per cm and their size are practically constant over a wide range of the final pressure; the foam limit does not depend on the final pressure. The sensitive time can be appreciably increased by an increase of the final pressure and there is a temperature range of a few degrees where the number of bubbles per cm is practically constant. A.

IONIZATION. THERMIONICS 537.56/58

537.568

8259. CHARGE EXCHANGE CROSS SECTIONS OF HYDROGEN IONS IN GASES. P.M.Stier and C.F.Barnett.
Phys. Rev., Vol. 103, No. 4, 896-907 (Aug. 15, 1956).

Measurements are reported of the cross-section for electron capture (σ_{10}), electron loss (σ_{01}), and electron detachment (σ_{-10}) for hydrogen atoms and ions traversing several gases. (σ_{if} represents the cross-section for charge transfer from initial state i to final state f.) The kinetic energy of the particle was from 3 keV to 200 keV. The target gases used were H_2, He, N_2, O_2, Ne and A. Cross-sections were determined by measuring the attenuation of the hydrogen beam in a gas cell under the influence of an electrostatic or magnetic field. The fraction of the beam in each charge state after passing through a "thick target" was also determined. This latter measurement served as a test for internal consistency of the data, since the fraction is relatable to the cross-section for entry to and exit from the charge state. The loss cross-section, σ_{01}, increased monotonically at low energies, reaching a maximum at a velocity approximately equal to the orbital electron velocity. For the higher energies studied the capture cross-section could be represented by an expression of the form, $\sigma = Ae^{-bv}$, where A and b are constants for each gas studied. The electron attachment cross-section, σ_{0-1}, was of the order 10^{-17} cm^2/gas atom for the gases studied and attained a maximum between 5 and 20 keV. The inverse transition, σ_{-10}, was approximately 10^{-18} cm^2/gas atom in the energy range studied. A.

537.571 : 539.155.2

8260. SEPARATION OF IONS ACCORDING TO THEIR MOBILITIES. S.E.Bresler and G.E Pikus.
Zh. tekh. Fiz., Vol. 26, No. 1, 109-25 (1956). In Russian.

Develops the phenomenological theory of the separation of ions when d.c. is passed through a molten metal. From the general equation for a unidimensional two-isotope system the authors obtain solutions for steady-state and non-steady-state conditions (general and special case). By applying these solutions to data of Haeffner (Abstr. 3772/1954) and Nief and Roth (Abstr. 10433/1954) the following values of $k = (\Delta\mu/\mu)/(\Delta M/M)$ (μ = ionic mobility, M = ionic mass) were obtained: for Hg, 0.04; for Ga, 0.12. In an attempt at explaining the higher mobility of the heavier isotope by its having a smaller radius, it is pointed out that one of the components of the radius (the amplitude of thermal vibration χ_T) would be smaller for the heavier than for the lighter isotope.

F.Lachman

537.581 : 538.561

8261. HIGH FREQUENCY OSCILLATIONS IN THE SPACE CHARGE OF SOME ELECTRON EMISSION SYSTEMS.
K.T.Dolder and O.Klemperer.
J. Electronics, Vol. 1, No. 6, 601-11 (May, 1956).

The occurrence of multiple electron sources in electron emission systems was investigated for thermionic filamentary cathodes in the form of a straight wire, of a hairpin and of a helical spiral. The experimental results are all consistent with the view that the occurrence of multiple sources is the result of standing electron space charge oscillations close to the cathode surface. The frequencies of these oscillations are believed to be between 10^8 and 10^9 c/s. A.

537.583

8262. THERMIONIC EMISSION CONSTANTS OF IRIDIUM. D.L.Goldwater and W.E.Danforth.
Phys. Rev., Vol. 103, No. 4, 871-2 (Aug. 15, 1956).

The thermionic constants of polycrystalline iridium have been measured with reasonable care using thin ribbons of iridium as the emitting specimens. The values obtained for the quantities A and ϕ, both considered as constant in the equation $i_S = AT^2 \exp(-\phi e/kT)$, are A = 170 amp. cm^{-2}. deg C^{-2}, ϕ = 5.40 V. The relationship between true and brigthness temperature at the pyrometer wavelength of 0.65μ was likewis determined. From the latter data, it was computed that the spectral emissivity ϵ_λ of iridium is 0.33 at that wavelength. Data taken on fresh specimens yielded values of the Schottky slope higher than expected, and values of A orders of magnitude above the theoretical values. (This experience parallels that of workers who have studied the thermionic properties of platinum.) The values reported were obtained after prolonged and rigorous thermal cleaning of the iridium. A.

537.583 : 621.385.032.213.13

8263. THE ELECTRON DONOR CENTERS IN THE OXIDE CATHODE. R.H.Plumlee.
RCA Rev., Vol. 17, No. 2, 231-74 (June, 1956).

The electronic chemical potential serves as the basis of a new interpretation of the chemistry of the oxide cathode in particular and of electronically active solids in general. Any procedure which raises the Fermi level of a material increase the electronic chemical potential of the material and corresponds chemically to making the material a stronger reducing agent. This principle allows disposal of several fundamental irregularities in earlier interpretations of cathode chemistry through which the F-centres, presumed to be formed from "excess barium" and oxygen vacancies, have been previously identified as the electron donors. On the basis of recent litera ture it is concluded that the F-centre model is not valid. With due regard to thermochemical and other physical properties deduced for the donor centres in the oxide cathode, and to the electrical properties of the donor centres as prescribed by the mobile donor theory, it is proposed to identify an impurity group, (OH^-.e), as the important electron donor centre specie in the oxide cathode. A detailed discussion is given of arguments leading to this model. A

537.583 : 621.385.032.213.13

8264. PRINCIPAL ELECTRON DONORS IN THE OXIDE CATHODE. R.H.Plumlee.
J. appl. Phys., Vol. 27, No. 6, 659-60 (June, 1956).

It is proposed that the main donor species are the OH^-.e group, a hydroxide group with an extra associated electron which preserves charge balance. For a fuller account see paper reported in preceding abstract. A.H.W.Beck

COSMIC RAYS 537.591

537.591

8265. SELECTED COSMIC-RAY ORBITS IN THE EARTH'S MAGNETIC FIELD. F.S.Jory.
Phys. Rev., Vol. 103, No. 4, 1068-75 (Aug. 15, 1956).

A set of 663 charged-particle orbits in the earth's dipole magnetic field has been obtained by integration, using the AVIDAC computer. The orbits integrated were selected according to their usefulness in the analysis of cosmic-ray inter sity increases associated with solar flares. The calculation of intensity increases for different locations on the earth is discussed using the orbit results. A

537.591.1

8266. ON THE PENETRATING NON-IONIZING COMPONENT OF COSMIC RAYS. G.Bozóki, E.Fenyves and L.Jánossy.
Nuclear Physics, Vol. 1, No. 7, 501-15 (June, 1956).

Investigations into the penetrating non-ionizing component of cosmic rays were carried out with an apparatus similar to that used by Jánossy and Rochester (1943), and the results of the former experiments were substantially confirmed and extended. The collision mean free path for the non-ionizing rays, which must be assumed to consist mainly of neutrons, was found to be $270 \pm 28\,g/cm^2$ in lead. This value is significantly greater than the mean value found for the primaries of penetrating showers. Problems concerning the reliability of the experimental method used are discussed. A.

537.591.1 : 523.72

8267. HIGH LATITUDE IMPACT ZONES FOR SOLAR COSMIC RAYS. W.L.Kraushaar.
Progr. theor. Phys., Vol. 14, No. 1, 78-9 (July, 1955).

It is suggested that some of the features of cosmic-ray intensity increases accompanying solar flares, which are not explained by the use of a simple dipole to represent the earth's magnetic field, can be explained in part by a galactic magnetic field which is suspected to lie along the spiral arms. High latitude impact zones should exist if there is such a field and if the particles are emitted from the sun over a wide range of angle; this would explain the large increases sometimes observed at high latitudes. D.J.A.Prowse

537.591.1

8268. IONIZATION SPECTRUM OF THE COSMIC RAY SOFT COMPONENT AT SEA-LEVEL. A.G.Meshkovskiĭ and L.I.Sokolov.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 840-9 (1956). In Russian.

A new method for investigating the ionization spectrum of cosmic ray particles has been developed. The ionization spectra of particles with ranges of 2—3, 3—5, 5—9 and 9—15 cm in lead have been determined. Conclusions concerning the composition of the proton component at sea-level within the indicated ranges are made. A.

537.591.15

8269. STATISTICAL METHOD TO EVALUATE THE ENERGY OF PARTICLES GENERATING SHOWERS OF ELECTRONS AND NUCLEONS. E.M.Fridlender (Friedländer).
Dokl. Akad. Nauk SSSR, Vol. 106, No. 5, 826-9 (1956). In Russian.

A statistical method, based on the analysis of data registered with the same shower detector at two different altitudes, has been developed in order to (a) evaluate the energy of the primary particles generating extensive air showers; (b) investigate the kind of interaction between high-energy nucleons and nuclei in the high layers of the atmosphere. The analysis of some previous measurements based on this method shows that the results fit considerably better the Fermi—Landau rather than the Heisenberg model. G.Martelli

537.591.15

8270. CASCADE CURVES OF ELECTRONS AND PHOTONS FOR LEAD. I.P.Ivanenko.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 6, 819-22 (1956). In Russian.

Curves have been calculated as a function of thickness for various values of the energy of the primary particle. Reasonable agreement with experimental curves is claimed. J.M.Hough

537.591.5 : 523.745

8271. THE OBSERVATION OF THE COSMIC RAY ERUPTION OF THE 23RD FEBRUARY 1956 IN FREIBURG-IM-BREISGAU. A.Sittkus, W.Kuhn and E.Andrich.
Z. Naturforsch., Vol. 11a, No. 4, 325-6 (April, 1956). In German.

The ion current in the ionization chamber cosmic ray monitor at Freiburg rose by a factor of 590% at 3.42 G.M.T. on the 23rd February 1956. Normal values were reached by 8.00 G.M.T., the decrease being exponential. Results from a coincidence counter telescope which records at half-hourly intervals indicate that the particles came in from a vertical direction and that the usual $\cos^2$ variation with zenith angle was not obeyed. At the high altitude station at Schauinsland, the apparatus for the recording of high energy extensive air showers ($> 10^{12}$ eV) registered no additional events during the eruption. D.J.A.Prowse

537.591.5 : 523.745

8272. THE RISE IN THE COSMIC RADIATION ON 23 FEBRUARY 1956. B.Meyer.
Z. Naturforsch., Vol. 11a, No. 4, 326 (April, 1956). In German.

The rise observed in the local neutron flux produced by low energy nucleonic component at Göttingen on the 23rd February is described. The measurements were made by means of a "Simpson pile". The abnormal count lasted for about 20 hours. D.J.A.Prowse

537.591.8

8273. THE MEAN CHARACTERISTICS OF THE ACT OF INTERACTION OF PRIMARY COSMIC PARTICLES OF VARIOUS ENERGIES (2-1000 BeV) WITH LIGHT ATOMIC NUCLEI. N.L.Grigorov.
Uspekhi fiz. Nauk, Vol. 58, No. 4, 599-666 (1956). In Russian.

An account of basic processes which determine the passage of cosmic rays through matter. Discusses the formation of π-mesons by primary particles, nuclear fissions in the atmosphere due to primary particles, the passage of nucleons of various energies through the atmosphere. 44 refs. C.R.S.Manders

MAGNETISM 538

538.113 : 539.11

A NOTE ON MOMENTUM CORRELATION AND DIAMAGNETISM. See Abstr. 7566

538.22.08 : 537.226.1.08

EXTENSION OF THE "THIN-SAMPLE METHOD" FOR THE MEASUREMENT OF INITIAL COMPLEX PERMEABILITY AND PERMITTIVITY. See Abstr. 7374

538.221 : 548.7 : 621.318.132

8274. EFFECT OF MAGNETOCRYSTALLINE ANISOTROPY ON THE MAGNETIC SPECTRA OF Mg-Fe FERRITES. G.T.Rado, V.J.Folen and W.H.Emerson.
Proc. Instn Elect. Engrs, Paper No. 2174 R, publ. Oct., 1956, 8 pp. To be republished in Vol. 104 B (1957).

Results of new experiments on magnesium-iron ferrites at 26° C and -196° C are presented. These include measurements of the first-order magnetocrystalline anisotropy constant K of monocrystals, and of the magnetic spectrum (the frequency dependence of the complex initial permeability) of polycrystals. If a newly observed inversion dependence of K is neglected, the values of K at room temperature are represented by $K = -85\,000x - 25\,000$ ergs/cm^3, where x is defined by the formula $(MgO)_{1-x}(FeO)_xFe_2O_3$. Frequencies between zero and 10^4 Mc/s were used for the magnetic spectra, and two or three pronounced dispersions were observed in each ferrite. Some earlier investigations concerned with the magnetic spectra of sintered ferrites possessing two broad dispersion regions are reviewed. It is concluded from the present

and earlier investigations that the r.f. dispersion region and the static initial permeability are primarily due to domain wall displacements, and that the microwave dispersion region is primarily due to domain rotations that occur in an effective field caused by magnetocrystalline anisotropy as well as by static and dynamic magnetic interactions. A.

538.221 : 548.7 : 621.318.12

8275. MAGNETOCRYSTALLINE ANISOTROPY IN COBALT-SUBSTITUTED MAGNETITE SINGLE CRYSTALS. L.R.Bickford, Jr, J.M.Brownlow and R.F.Penoyer.
Proc. Instn Elect. Engrs, Paper No. 2188 S, publ. Oct., 1956, 7 pp. To be republished in Vol. 104 B (1957).

The growth of single crystals corresponding to x = 0 (high-purity magnetite), x = 0.01 and x = 0.04 in the composition series $Co_xFe_{3-x}O_4$ is described. First- and second-order anisotropy constants of these crystals are determined by the torque method over the temperature range 120-450°K. The substitution of small amounts of Co for Fe is found to add a positive contribution to K_1 and a negative contribution to K_2. At low Co concentrations the magnitude of this contribution is a linear function of the amount of Co added. It is suggested that the effect of Co on the anisotropy is enhanced by the presence of divalent Fe in magnetite, and it is concluded that the change in sign of K in magnetite at about 130°K is not caused by the presence of Co or any other foreign impurity. A.

538.221

8276. ROTATIONAL LOSSES IN 4-79 MOLYBDENUM PERMALLOY AT LOW FREQUENCIES. J.M.Kelley.
Phys. Rev., Vol. 103, No. 2, 499-500 (July 15, 1956).

Measures the average torque (proportional to the rotational loss) on disk-shaped specimens in rotating fields up to 1.13×10^4 oersted and at frequencies up to 60 c/s. After subtracting eddy current contributions the anomalous additional torque was found to be frequency independent. E.P.Wohlfarth

538.221

8277. SOME PROPERTIES OF THE COERCIVE FORCE IN SOFT MAGNETIC MATERIALS. D.S.Rodbell and C.P.Bean.
Phys. Rev., Vol. 103, No. 4, 886-95 (Aug. 15, 1956).

The coercive force is the value of the magnetic field amplitude when the net magnetization in the direction of the field is zero and has a zero time rate of change. An equivalent definition of the coercive force is contained in the expression for the average instantaneous domain wall velocity; $v = k(H-H_C)$, in which k depends upon motional energy losses and H is the applied magnetic field: H_C is the coercive force. This latter definition was used to measure the coercive force in specimens of magnetically annealed 65 Permalloy (65% Ni-Fe) tapes and a 3.25% SiFe picture frame single crystal for both low- and high-field domain configurations. The coercive force measured in this way for low applied fields is the same as that determined by other techniques. For the high-field determination, with domain walls unattached to the specimen surfaces, the coercive force is, for these samples, less than half the low-field coercive force. The authors call the value determined at high fields the "internal coercive force" and believe this value to be characteristic of the bulk material. The low-field coercive force includes both the "internal coercive force" and a component due to preferential "pinning" of domain walls at the specimen surfaces. The experimentally observed dependence of the coercive force upon specimen thickness may be explained using surface pinning of domain walls. This explanation was previously postulated by Kijkstra. The difference in coercive force between surface free and surface pinned domain walls may be used to make a lower limit estimate of the domain wall energy density. The results are in order of magnitude agreement with the values expected from theory. Considerations of the experimentally determined expression for domain wall velocity given above show that the positional free-energy variations which determine the coercive force cannot be described by conservative periodic functions. A.

538.222

8278. PARAMAGNETIC RESONANCE SPECTRA OF THE ALKALI SUPEROXIDES AND CHLORINE DIOXIDE.
J.E.Bennett, D.J.E.Ingram and D.Schonland.
Proc. Phys. Soc. A, Vol. 69, Pt 7, 556-65 (July, 1956).

The paramagnetic resonance absorption spectra are described in detail and a theoretical analysis is made of the results in terms of molecular orbital theory. The unpaired electron is associated with the binding orbitals in each case and the variation of g values and hyperfine splitting are used to calculate the details of the energy levels. Variation of the spectra with temperature has also been studied and has revealed an averaging effect on the chlorine hyperfine structure due to the "tumbling" motion of the solvent molecules. A.

538.222

8279. PARAMAGNETIC RESONANCE IN CHROMIC METHYLAMINE ALUM. J.M.Baker.
Proc. Phys. Soc. B, Vol. 69, Pt 6, 633-41 (June, 1956).

The paramagnetic resonance spectrum of chromic methylamine alum has been re-examined because of an 11% discrepancy in the value of the Stark splitting between previous paramagnetic resonance and other low temperature measurements. The crystalline electric field acting on the chromic ion, which has trigonal symmetry at high temperatures, is found to undergo a change below about 160°K to rhombic symmetry. The Stark splitting is then 0.178 ± 0.002 cm^{-1}; this is a little higher than the previous resonance value, reducing the discrepancy to 5%. Measurements of line width indicate that this discrepancy is probably not due to exchange interaction. A.

538.222

8280. RECORDING MAGNETIC-RESONANCE SPECTROMETER. M.W.P.Strandberg, M.Tinkham, I.H.Solt, Jr and C.F.Davis, Jr.
Rev. sci. Instrum., Vol. 27, No. 8, 596-605 (Aug., 1956).

Apparatus especially designed for studying electron paramagnetic resonance is described and discussed. A magnet of novel yokeless design is presented. Field stabilization and modulation procedure is considered. The microwave sample cavity is analysed to determine conditions for optimum operation. The klystron stabilization problem is examined. Appropriate lumped circuits for low-frequency operation are described. The signal amplification and presentation system is treated in detail. A.

538.222 : 536.421.1

8281. CHANGE OF MAGNETIC SUSCEPTIBILITY OF TRANSITION METALS AND ALLOYS AT THEIR MELTING POINT. Y.Nakagawa.
J. Phys. Soc. Japan, Vol. 11, No. 8, 855-63 (Aug., 1956).

The magnetic susceptibility of Mn, Fe, Co, Ni and their alloys has been measured through their melting points up to 1600°C. In general, the susceptibility of transition metals shows a decrease or an increase on melting, depending on whether the interatomic interactions favour parallel alignment of atomic magnetic moments or not, indicating that the interactions are always weaker in liquid than in solid. Although some Fe alloys of face-centred cubic lattice form exceptions to the above simple rule, they are also explained on the basis of the Bethe–Slater exchange interaction curve together with the volume increase on melting. It is to be noted that a remarkable supercooling of liquid, often exceeding one hundred degrees, has been observed during the course of these susceptibility measurements. A.

538.224 : 537.311.33

8282. FURTHER MEASUREMENTS ON THE MAGNETIC SUSCEPTIBILITY OF GERMANIUM DOWN TO LIQUID HELIUM TEMPERATURES. A.van Itterbeek and W.Duchatea
Physica, Vol. 22, No. 8, 649-56 (Aug., 1956).

Measurements were made on seven samples of germanium obtained from single crystals of very pure germanium or of germanium containing small amounts of Sb (10^{14}, 10^{15}, 10^{17}). The measurements were carried out between room temperature and liquid helium temperatures. For the pure samples an increase was found of the diamagnetic susceptibility of about 5% between room and liquid hydrogen temperatures. In the liquid helium region the susceptibility was nearly constant. For the impure samples the increase of the diamagnetic susceptibility between room temperature and the liquid hydrogen temperature region is about 11% and 18%. For the sample with the greatest concentration of Sb, a minimum is found in the susceptibility versus temperature between liquid hydrogen and liquid helium temperatures. A paramagnetic term appears at the lowest temperatures. In order to check the precision of the method, measurements were also carried out on a sample of piezoelectric quartz. A susceptibility was found which was constant within 0.2% between room temperature and liquid helium temperatures. A.

538.245

8283. SPONTANEOUS MAGNETIZATION AND MAGNETIC SUSCEPTIBILITIES OF AN ANTIFERROMAGNETIC WITH FOREIGN IONS IN ONLY ONE SUBLATTICE. K.F.Niessen.
Philips Res. Rep., Vol. 11, No. 3, 172-82 (June, 1956).

A study is made of an antiferromagnetic in one of whose sublattices a relatively small number of original A-ions is supposed to be replaced by ions of another metal B, the moment m of B being different from the moment m of A. The magnetization is then no longer zero. Its dependence on the temperature is investigated and also the change in the parallel and perpendicular susceptibilities due to the above replacement. A.

538.27 : 539.219

8284. THE DE HAAS-VANALPHEN EFFECT IN ALLOYS. V.Heine.
Proc. Phys. Soc. A, Vol. 69, Pt 7, 505-12 (July, 1956).

The theory of primary solid solutions is applied to the de Haas-van Alphen effect in dilute alloys. The experimental results are largely in agreement with the theory, except where there is the possibility of the existence of a bound state round the solute atoms. The de Haas-van Alphen effect appears to be well suited for studying this phenomenon as well as the effect of solutes from different rows of the periodic table. A.

ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3 : 530.162

8285. STATISTICAL MECHANICS OF MATTER IN AN ELECTROMAGNETIC FIELD. II. ON PRESSURE AND PONDEROMOTIVE FORCE IN A DIELECTRIC. P.Mazur and S.R.de Groot.
Physica, Vol. 22, No. 8, 657-69 (Aug., 1956).

For Pt I see Abstr. 2591 (1954). A statistical mechanical derivation of the expressions for both pressure and ponderomotive force in a dielectric is given in terms of averages over microscopic quantities. The existence of microscopic long-range interactions leads to the possibility of defining pressure and ponderomotive force in different ways. A natural way is indicated of dividing the average of the microscopic force into long and short range contributions, which yields the form of the ponderomotive force proposed by Kelvin. It is also shown that, in statistical equilibrium, one may obtain Helmholtz's expression for the ponderomotive force. In the two cases pressure must be defined differently. The relation between these pressures is as predicted by thermodynamic theory. A.

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56.029.6 : 621.3.011

8286. ON METHODS OF MICROWAVE OPTICS. K.Bochenek and J.Plebański.
Arch. elektrotech. (Warsaw), Vol. 5, No. 2, 293-323 (1956). In Polish.

In this paper two approximation methods developed on the basis of geometrical optics are proposed for treating electromagnetic fields. The purpose of these methods is to facilitate the analysis of microwave problems. The two processes presented here are different from those found in the literature available to the authors. According to the first method a solution of the equation $(\Delta + k^2)u = 0$ is sought in the form $u = Ae^{ik_0L}$. The expression $\sqrt{[1 + (1/k_0^2)(\Delta A/A)]}$ stands for an effective refractive index and, if required, it can be determined to an accuracy of a small order of magnitude with respect to $1/k_0$. This interpretation is analogous to the quantum mechanical interpretation of D.Bohm. The boundary value problem for the equation $(\Delta + k^2)u = 0$ is transformed into a Cauchy problem for the set of equations for the successive term of the expansion of A and L in k_0^{-1}. The second method takes the W.K.B. approximation as a starting point. This means that a solution of the equation $(\Delta + k^2)u = 0$ is sought in the form $u = e^{ik_0\Lambda}$, where the function Λ is a complex one and depends on k_0 as $\Lambda = \sum_{n=0}^{\infty} (1/ik_0)^n {}_n\Lambda$. This leads to the set of Cauchy problems for the function ${}_n\Lambda$. The first approximation (with the index 0) has the same relation to non-homogeneous plane wave as geometrical optics has to ordinary plane wave. The above-mentioned Cauchy problems for complex functions can be in general effectively solved. Both methods are illustrated by sample calculations. A.

538.561

8287. THE DISPERSION EQUATION IN PLASMA OSCILLATIONS. P.C.Clemmow and A.J.Willson.
Proc. Roy. Soc. A, Vol. 237, No. 1208, 117-31 (1956).

A theory is developed of longitudinal oscillations in an infinite homogeneous neutral electron gas in which the thermal speeds of the electrons are taken into account, but collisions and the motion of positive ions are neglected. A perturbation method is used and the existence of oscillations which are harmonic in space and time is investigated. The treatment is relativistic and yields a dispersion equation relating the angular frequency ω and the propagation constant k of such an oscillation. It is shown that to any real positive value of ω^2 in the range extending from zero to an upper limit just beyond ω_0^2, where ω_0 is the plasma frequency, there corresponds a real value of k^2 which satisfies the dispersion equation; but that no other solution of the dispersion equation exists for which either ω^2 or k^2 is real. For the case of an unperturbed electron distribution function of Maxwellian type the dispersion equation is expressed in terms of the probability integral and is examined in detail. Some remarks are offered on the initial value problem in which the disturbance is specified at zero time. A.

538.561

8288. SHAPE OF THE SPECTRAL LINE OF A GENERATOR WITH FLUCTUATING FREQUENCY. A.N.Malakhov.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 884-8 (1956). In Russian.

The present investigation is a continuation of Berstein's work on the natural line-width and Gorelik's work on the "technical" width of the line of a radiowave generator. A.

538.565 : 621.372.413.011

8289. EXCITATION AND SEPARATION OF PURE HIGH-ORDER MODES IN LARGE HIGH-Q CAVITIES. C.T.Zahn and W.G.Schweitzer, Jr.
J. appl. Phys., Vol. 27, No. 8, 929-37 (Aug., 1956).

In order to extend the range of cavity resonance techniques a successful method has been developed for the suppression of undesired modes of a densely populated cavity spectrum. It is based on the nodal properties of the usual simple solutions of the wave equation. The analytic continuation of any such solution may be regarded as a master mode pattern which defines an infinite variety of elementary cavities or cells all having one frequency in common. These properties provide the basis for a novel principle in the design of cavity-coupling systems. By suitable choice of a "complex" of these elementary cells, devices can be obtained with remarkable transducing, filtering, or suppressing properties. An experimental test of the foregoing ideas has been made in which it was possible to excite a well-separated very high order $TE_{om\nu}$ mode in a large cylindrical cavity, at a frequency of 20 000 Mc/s. The observed Q for this preferred mode was of the order of one million. As an additional test quantitative experiments have been performed on a special type of complex cavity in which the number of elementary cells could be varied. A.

538.565 : 621.317.321 : 621.385

8290. "GLO-BALL" DEVELOPMENT. J.F.Steinhaus.
Rev. sci. Instrum., Vol. 27, No. 8, 575-80 (Aug., 1956).

The term "glo-ball" is used to designate a small, thin-walled, partially evacuated glass sphere containing helium, used for investigating electric field distributions in r.f. resonant cavities. Ionization, or firing, of the gas in the glo-ball indicates a given potential gradient across it; in field investigations a monitoring loop is used to record the voltage required in the cavity to produce this ionization. Glo-balls were developed specifically for their application to linear accelerators. Experiments were conducted to provide a method of making glo-balls, under controlled conditions with known constituents, that would have a stable and relatively low firing gradient. Factors associated with the making of a glo-ball were determined, and a spectroscopic analysis identified the gas components. It is now possible to make a ball that fires at a minimum voltage gradient with excellent stability. Other characteristics of the glo-ball pertinent to its use as a field-measuring device were investigated. A.

538.566 : 621.396.677.85

8291. A HOMOGENEOUS DIELECTRIC SPHERE AS A MICROWAVE LENS. G.Bekefi and G.W.Farnell.
Canad. J. Phys., Vol. 34, No. 8, 790-803 (Aug., 1956).

A homogeneous dielectric sphere illuminated by a small external source of electromagnetic radiation will be free, because of its special symmetry, from all off-axis aberrations such as coma and astigmatism. If the only monochromatic aberration, namely spherical aberration, is not too excessive or if it is partially corrected by a suitably designed source, a sphere could be used for purposes of rapid scanning of a microwave beam through an angle of 360° of arc without moving the lens. This possibility was investigated by computations based on geometrical optics and on the diffraction theory of optical aberrations. The results suggest that a sphere of fairly small refractive index and less than about 30 wavelengths in diameter will produce a good diffraction image of a point source. Methods are also discussed of designing appropriate sources for use with larger spheres. A.

538.566 : 621.396.674.3 : 621.372.833.1

8292. ON TRANSIENT RADIATION OF A DIPOLE INSIDE A WAVE GUIDE. I. R.Gajewski.
Acta phys. Polon., Vol. 15, No. 1, 25-41 (1956).

Exact formulae are given for an electromagnetic field radiated by a dipole situated inside a waveguide of an arbitrary cross-section, the moment of the dipole depending on time through a factor $1(t)\ (1 - e^{-\rho t}) \sin \omega_o t$, where 1(t) is the Heaviside's step function. A.

538.566

8293. ELECTROMAGNETIC WAVES IN A RECTANGULAR WAVEGUIDE FILLED WITH A MAGNETIZED FERRITE. A.L.Mikaélyan.
Dokl. Akad. Nauk SSSR, Vol. 98, No. 6, 941-4 (1954). In Russian.

Normal modes are determined for a slab bounded by ideally conducting planes and filled by anisotropic ferrite magnetized uniformly parallel to the z-axis.

Mathematical Reviews

538.566.2 : 621.396.11

8294. DIFFRACTION OF ELECTROMAGNETIC WAVES FROM A NON-IDEALLY CONDUCTING WEDGE AND THE PROBLEM OF COASTAL REFRACTION. V.A.Il'in.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 1, 47-50 (1954). In Russian.

The method of a previous paper is applied to give an approximate expression for the magnetic potential due to a line source in the presence of such a wedge. An image method is used to find another approximate solution in the case when the wedge angle is a submultiple of π. Qualitative deductions are made regarding the effect on signal strength, for various polarizations, of the nearness of the transmitter to a coastal line. Mathematical Reviews

538.566.3 : 621.396.11

8295. DOPPLER EFFECT IN IONOSPHERIC PROPAGATION. S.Borowski, S.Jasiński and S.Manczarski.
Arch. electrotech. (Warsaw), Vol. 5, No. 2, 343-53 (1956). In Polish.

Measurement of frequency variations due to Doppler effect given by various authors vary widely, even to the extent of several orders. Some authors associate the appearance of a strong Doppler effect with the great variability of the angle of incidence of the waves on the ionosphere. This paper contains a mathematical analysis of the general problem as well as an analysis of the measurement and observations of the effect. A formula expressing the variation of frequency caused by the motion of the ionosphere has been derived on the basis of geometrical optics. Calculations made using this formula give a small change of frequency. The formula can be used as long as the operating frequency is not too close to the ionospheric maximum usable frequency. In this case geometrical optics is no longer applicable. Near this limit the ionosphere behaves like a selective low-pass filter for the waves returning to the earth, whereby the parameters of this filter are constantly changing. As a result of the changes arising in this manner, a single impulse returning to the earth is broken up into a series of short wave-trains. If these wave-trains are studied with the aid of the Fourier integral, we obtain a wide frequency spectrum which is more or less in agreement with the data obtained by some authors. Analysis shows that the wide spectra appear only in the limiting conditions, which certainly occur considerably less often than the average ones. To confirm this fact experimentally, a series of observations were made at Warsaw and Grodzisk (Poland). The treatment presented by the authors provides an explanation of the correlation between the Doppler effect and the great variability of the angle of arrival of ionospheric waves. In carrying out measurements based on the reception of standard frequencies from distant short-wave radiostations an approach to the limiting conditions should be avoided. A.

538.566.3

8296. POLARIZATION OF THE ECHOES FROM THE IONOSPHERE. J.K.D.Verma and R.Roy.
Indian J. Phys., Vol. 30, No. 1, 36-46 (Jan., 1956).

Some experimental studies on the polarization characteristics of the echoes from the ionospheric layers have been presented. The details of an improved type of radio polarimeter which can work in conjunction with a high-resolution radio sonde equipment have been described. The high resolv-

ing limit of the equipment made it possible to record the true polarization patterns of the echoes due to normal reflection and those due to irregularities in the ionized regions. A method has been indicated for the identification of the thin-layer type of E_s echoes from other types on the basis of their polarization characteristics. A.

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

8297. THE BAND STRUCTURE OF BISMUTH. V.Heine.
Proc. Phys. Soc. A, Vol. 69, Pt 7, 513-19 (July, 1956).

The properties of bismuth and its alloys are considered, with a view to deciding whether or not the band structure is such that there are only 1.5×10^{-5} free electrons per atom with the same number of holes. It is shown that there is considerable evidence that such is the case. There appear to be no facts that directly contradict this view, but not all the properties of bismuth can be accounted for in detail. The inadequacy of the Landau-Peierls formula for the diamagnetism of conduction electrons appears to be well demonstrated, but this does not affect the usual interpretation of the de Haas-van Alphen effect in terms of the shape of the Fermi surface. A.

539.11

8298. CALCULATIONS ON THE BAND STRUCTURE OF SILICON. D.P.Jenkins.
Proc. Phys. Soc. A, Vol. 69, Pt 7, 548-55 (July, 1956).

The electronic band structure of silicon has been calculated along two axes of momentum space. The results agree qualitatively with experiment, but quantitative values are distorted by uncertainties in the potential used. The variational cellular method used is not too laborious in application, but appears to suffer from unexpected disadvantages at low-symmetry points in momentum space. A.

539.11 : 530.145

8299. QUANTUM-STATISTICAL MECHANICS OF ELECTRON–PHONON SYSTEM. T.Matsubara.
Progr. theor. Phys., Vol. 13, No. 6, 628-30 (June, 1955).

Extending the Goldberger–Adams method (Abstr. 2436/1952) and using the techniques of modern quantum electrodynamics, a method of calculating the grand partition function is demonstrated for the case of the electron–phonon system. W.A.Hepner

539.11 : 530.145

8300. QUANTUM STATISTICAL MECHANICS OF ELECTRON—PHONON SYSTEM. H.Ichimura.
Progr. theor. Phys., Vol. 15, No. 2, 151-66 (Feb., 1956).

The problem of the interaction between conduction electrons and the thermal vibration of the lattice ions in the metal is treated by a statistical mechanical method. The free electron and the phonon models are adopted as usual, using the Bloch—Bethe type interaction Hamiltonian. By the method of expanding the grand partition function in powers of the interaction parameter, a formula is obtained for the free energy of the system of conduction electrons in the presence of the interaction. A technique analogous to the renormalization method in quantum mechanics is utilized in the calculation. A.

539.11 : 548.7

8301. THEORY OF INTERACTION OF EXCITONS WITH THE PHONON FIELD. V.A.Moskalenko.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 959-61 (1956). In Russian.

Modifications in the exciton energy levels arising from the phonon field are calculated using the effective mass approximation in the Hamiltonian. G.E.Brown

539.11

8302. SOME PROPERTIES OF VACANCIES AND INTERSTITIALS IN Cu_3Au. R.A.Dugdale.
Phil. Mag. (Ser. 8), Vol. 1, No. 6, 537-59 (June, 1956).

A series of experiments, based on electrical resistivity measurements, have resulted in the following conclusions: The activation energy for formation of vacancies is about 1.0 eV and for migration about 0.9 eV. The ordering process, involving the interaction of vacancies with wrong atoms, is complex; at least two relaxation processes are shown to operate. The decay time of an excess vacancy concentration appears to be limited by the presence of vacancy capturing impurities, the concentration of which can be varied by suitable heat treatment. Interstitials are more mobile than vacancies at a given temperature, but these too are probably trapped and can in turn contribute to the limitation of the vacancy decay time. A.

539.11

8303. DIRECT MEASUREMENT OF MOLECULAR ATTRACTION OF SOLID BODIES. I. STATEMENT OF THE PROBLEM AND METHOD OF MEASUREMENT OF FORCES USING NEGATIVE FEEDBACK. B.V.Deryagin and I.I.Abrikosova.
Zh. éksper. teor. Fiz., Vol. 30, No. 6, 993-1006 (1956). In Russian.

It is shown that investigation of molecular attraction in macroscopic bodies as a function of the distance between their surfaces is a problem which is important from the principle as well as the practical viewpoint. The method of calculation of the corresponding interaction based on the assumption of additivity of the London forces is criticised. The physical basis and results of E.M.Lifshits's macroscopic theory of attraction of macro-bodies are briefly presented. The main experimental difficulties of measurement of molecular attraction of solid bodies as a function of the gap between them are discussed and it is shown how they are removed in the microbalance with negative feedback constructed by the authors. Special attention is paid to the removal of surface electrical charges by ionizing the air near the bodies. A.

539.11 : 536.71

EQUATION OF STATE OF SOLIDS. See Abstr. 7364

MOLECULES 539.13

539.13 : 533.7

CONCEPT OF INTERMOLECULAR FORCES IN COLLISIONS. See Abstr. 7207

539.132

8304. TEST OF THE WORKABILITY OF LOTMAR'S POTENTIAL ENERGY FUNCTION. N.R.Tawde and N.V.Gejji.
Indian J. Phys., Vol. 30, No. 6, 299-302 (June, 1956).

Lotmar, while examining some potential energy functions, found that the function of Rosen and Morse was better than those of Morse and of Pöschal and Teller. He, however, improved upon the function of Rosen and Morse. The condition for the workability of this improved function of Lotmar is derived in this paper and is tested in the case of certain molecules. A.

539.132

8305. SPECTROSCOPIC CONSTANTS OF MOLECULES. V. SIMILARITIES IN CONSTANTS OF DIFFERENT GROUPS. Y.P.Varshni and K.Majumdar.
Indian J. Phys., Vol. 30, No. 6, 303-12 (June, 1956).

For Pt IV, see Abstr. 3057 (1956). It is shown that ω_e of diatoms of 4b-7b groups are linear with ω_e of corresponding diatoms of the 4b-6b group. Other constants, viz. $\omega_e x_e$, r_e and D_o, are also found to give similar results. The resemblances between the vibration frequencies of corresponding halides of different groups have been pointed out. A.

539.132 : 535.343

NEAR INFRARED SPECTRUM OF DCl. See Abstr. 7290

539.132

8306. ONE-CENTER EXPANSION OF MOLECULAR WAVE FUNCTION. S.Huzinaga.
Progr. theor. Phys., Vol. 15, No. 5, 501-7 (May, 1956).

The possibility of expanding molecular wave functions into a series of functions with a single centre is examined. The calculations are performed for the ground-state energies of H_2^+ and H_2 with reasonable results. For example, a simple expansion yields 3.80 eV as the binding energy of H_2. The advantage of this method is, above all, its simplicity in calculations.

A.

539.132

8307. NUCLEAR QUADRUPOLE SPECTRA OF β, γ AND δ HEXACHLORCYCLOHEXANES. J.Duchesne, A.Monfils and J.Depireux.
C.R. Acad. Sci. (Paris), Vol. 243, No. 2, 144-5 (July 9, 1956). In French.

The quadrupole resonances of β, γ and δ hexachlorcyclohexanes are measured at 77°K, 164.5°K and 293°K and are near 37 Mc/s. The symmetrical β isomer snows one resonance, but the others each show 6 frequencies which may be related to the lengths of the different C—Cl bonds.

D.H.Whiffen

539.132

8308. NUCLEAR QUADRUPOLE COUPLING CONSTANTS AND VIBRATIONAL STATES. J.Duchesne.
J. chem. Phys., Vol. 25, No. 2, 368-9 (Aug., 1956).

A relationship $U_p = 14.776\ A^{-0.875}$ is proposed between the quadrupole coupling constant $U_p = 100\ eQq$ and its change with internuclear distance $A = |\Delta eQq/eQq \times \Delta r|$ which is obtainable from the change of coupling with vibrational quantum number, r being the change in internuclear distance. The relationship holds for alkali halides and methyl halides. Large A are associated with nearly pure ionic or nearly covalent bonds.

D.H.Whiffen

539.132 : 535.333

MAGNETIC HYPERFINE STRUCTURE IN BISMUTH HYDRIDE AND DEUTERIDE. See Abstr. 7272

539.132

8309. ATOMIC ORBITAL MODIFICATION IN MOLECULE FORMATION. D.P.Craig and E.A.Magnusson.
J. chem. Phys., Vol. 25, No. 2, 383-4 (Aug., 1956).

The formation of covalent bonds has been described in terms of polarization of d orbitals by ligand atoms. This polarization may be brought about by contraction of highly projecting orbitals due to increased effective nuclear charge. For an idealized model this effective nuclear charge is calculated as function of the separation between central atom and ligands.

J.Jacobs

539.132

8310. MOLECULES WITH TETRAHEDRAL AND OCTAHEDRAL SYMMETRY. V. THE ELECTRON DISTRIBUTION IN CCl_4. K.E.Banyard and N.H.March.
Proc. Cambridge Phil. Soc., Vol. 52, Pt 2, 280-6 (1956).

The modified Thomas–Fermi method reported in Pt IV (Abstr. 3899/1956) has been applied numerically to calculate the distribution of valence electrons in CCl_4. Slater wave functions have been used to describe the Cl inner-shell electrons, whilst a description of the C 1s electrons based on the Thomas–Fermi model for atoms has been adopted. The electron distribution thus found is compared with the two approximations discussed in Pt I. The first of these, in which valence and inner-shell electrons are treated in the same way, is shown to give a distribution of valence electrons in good agreement with the present results. The second approximation, that of effective nuclear charges, is less satisfactory and could only lead to a distribution of valence electrons in reasonable agreement with the present work if the effective nuclear charges were considerably reduced. This seems to throw some light on the results of Bowers for the force constants of tetrachloride and tetrabromides. The overall distribution of electrons obtained here seems to be the inevitable result of assuming the valence electrons to move in any plausible central field. It is, of course, by no means certain that such an approximation is near to the truth. In fact, the results of Pt I and the present paper leave little doubt that the electron cloud obtained by such an approximate method will be too diffuse. This seems at least partly responsible for the finding that rather more than 20 of the 28 Cl valence electrons lie outside the sphere drawn through the Cl nuclei.

A.

539.132

8311. INFRARED ABSORPTION STUDIES ON THE HYDROGEN BONDS BETWEEN VARIOUS PHENOL DERIVATIVES AND SOME PROTON ACCEPTORS. Y.Sato and S.Nagakura.
Sci. of Light (Tokyo), Vol. 4, No. 2, 120-9 (Nov., 1955).

This was investigated in detail by measuring the first overtone absorption of the O-H stretching vibration of a proton donor with a grating spectrometer of great resolving power; two new bands were found in the longer wavelength side of the O-H stretching vibration of a free proton donor when it takes part in hydrogen bonding. Furthermore, it is concluded, from experiment on their dependences on temperature and concentration of proton acceptor, that the bands should be due to the formation of hydrogen bonding. Such an occurrence of two absorption bands can approximately be explained by assuming a double minimum potential energy for hydrogen taking part in the hydrogen bond. It is found that the accepting powers of nitromethane and acetonitrile are smaller than those of dioxane and acetone, and is shown that for the interpretation of the hydrogen bond, delocalization energy of non-bonding electrons, which belong to the proton acceptor atom taking part directly in the formation of the hydrogen bond, is more important than mere electrostatic interaction.

A.

539.132

8312. PARAMAGNETIC RESONANCE IN DILUTE IRON GROUP FLUORIDES. I. FLUORINE HYPERFINE STRUCTURE. M. Tinkham.
Proc. Roy. Soc. A, Vol. 236, No.1207, 535-48 (1956).

The paramagnetic resonance spectra of Mn^{2+}, Fe^{2+}, Co^{2+} and Cr^{3+} ions present substitutionally in a ZnF_2 lattice are reported. The temperature-dependence of the anisotropy of the susceptibility in the case of Fe was also studied. In addition to the usual spin Hamiltonian tensor parameters g, D and A, there are data on the hyperfine structure coupling tensors A^N between the magnetic electrons and the surrounding six fluorine nuclei. In all cases except Cr^{3+}, where there are no σ-bonding electrons, the fluorine h.f.s. intervals are of between 10 and 20 G. With Cr^{3+}, no fluorine h.f.s. is resolved. It is suggested that the two types of Cr^{3+} spectra observed correspond to the two most natural sites for a monovalent charge-compensating cation.

A.

539.132

8313. PARAMAGNETIC RESONANCE IN DILUTE IRON GROUP FLUORIDES. II. WAVE FUNCTIONS OF THE MAGNETIC ELECTRONS. M.Tinkham.
Proc. Roy. Soc. A, Vol. 236, No. 1207, 549-63 (1956).

The data on the g, A and D tensors and on the fluorine hyperfine structure coupling tensors for paramagnetic ions in a ZnF_2 lattice are interpreted in terms of 3d orbitals augmented by attached fluorine wave-functions of appropriate symmetry. It is suggested that fluorine 3s and 3p functions are required, in addition to the 2s and 2p functions usually assumed, to give quantitative agreement between the fluorine h.f.s. coupling and the spin-orbit coupling reduction effects. The presence of

n = 3 functions also renders the dependences on internuclear distance more easily understood. Charge transfer by π- and σ-bonding seems to be of the same order, but the s-electron contact interaction of the σ-bonding electrons gives the dominant h.f.s. interaction. Particularly complete analyses are possible for Mn^{2+} and Fe^{2+}. In these cases, it is estimated that the magnetic electrons have a probability of about 6% of being in fluorine n = 2 orbitals, about the same of being in fluorine n = 3 orbitals, roughly 25% of being in the overlap region, leaving only about (60 ± 10)% probability of being on the central ion. The charge transfer in the case of Co^{2+} is believed to be less, and perhaps more typical of the situation when the ions are in their own lattices, with proper lattice parameter. The absence of resolved fluorine h.f.s. with Cr^{3+} is consistent with the absence of dγ electrons in the $3d^3$ configuration in an octahedral environment. A.

539.133

8314. PARAMAGNETIC RESONANCE OF LIQUID SULFUR: DETERMINATION OF MOLECULAR PROPERTIES.
D.M.Gardner and G.K.Fraenkel.
J. Amer. Chem. Soc., Vol. 78, No. 14, 3279-88 (July 20, 1956).

Paramagnetic resonance spectra have been obtained at temperatures from 189 to 414°. The paramagnetism, which increases reversibly with temperature, provides direct confirmation for the existence of long-chain sulphur polymers, and the results obtained are in quantitative agreement with the predictions of the theory due to Gee that postulates an equilibrium between long chains and S_8 rings. The heat of scission of sulphur-sulphur bonds in a long chain was found to be 33.4 ± 4.8 kcal/mole. The concentration of radicals at 300° was found to be $(1.1 \pm 0.6) \times 10^{-3}$ mole/l. and the average chain length is estimated to reach a maximum value of $(1.5 \pm 0.7) \times 10^6$ at 171°. Good agreement exists between these values and the estimates obtained from interpretation of the heat capacity data. The line width of the resonance increases markedly with temperature, but the spectroscopic splitting factor (g-value) is independent of temperature. The behaviour of the line width is interpreted as evidence for a rapid radical displacement reaction giving for the rate constant $k = 2.8 \times 10^8 \exp(-3100/RT)1.(g\text{-atom})^{-1}\ \text{sec}^{-1}$. Paramagnetic resonance spectra have also been observed from the black specks obtained by heating sulphur of ordinary purity. A description is given of the techniques of high temperature paramagnetic resonance spectroscopy and of the methods of obtaining absolute and relative paramagnetic intensities. A.

539.133 : 537.226.1

INFLUENCE OF MOLECULAR ELECTRIC QUADRUPOLE MOMENTS ON DIELECTRIC CONSTANTS. See Abstr. 7371

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152.1

8315. THE TWO-BODY SPIN-ORBIT FORCE. G.Abraham.
Nuclear Physics, Vol. 1, No. 6, 415-19 (May, 1956).

A first-order estimate is made of the two-body spin-orbit force from the ^2P splitting of Li^7. Considered together with recent work on He^5, the estimated spin-orbit force makes a large change in the calculation of the binding energy of the deuteron. A.

539.152.1

8316. ZERO-ZERO TRANSITION IN CARBON-12.
B.F.Sherman and D.G.Ravenhall.
Phys. Rev., Vol. 103, No. 4, 949-55 (Aug. 15, 1956).

The electric-monopole transition density between the ground state and the 7.68 MeV level of C^{12} is examined on the basis of the nuclear shell model. It is found to vanish for all stages of intermediate coupling if only the $(1p)^8$ configuration is involved. A nonzero value is obtained by including states of the $(1p)^7(2p)$ configuration, brought in by a residual central internucleon interaction. For computational simplicity, both this and the spin-orbit interaction are first treated as perturbations about the LS limit. Since the results show that the residual interaction, is probably too large for this to be reliable, an attempt is made to diagonalize the Hamiltonian exactly, but the severe restriction on the number of states considered makes the result rather unsatisfactory. It is concluded that if all of the possible states of the low-lying configurations were to be included in the diagonalization, agreement with experiment might result, but that in this case some semicollective model might better be applied to the problem. A.

539.152.1

8317. NUCLEON–HOLE INTERACTION IN jj COUPLING.
S.P.Pandya.
Phys. Rev., Vol. 103, No. 4, 956-7 (Aug. 15, 1956).

A theorem connecting the energy levels in jj coupling of a nucleon–nucleon and nucleon–hole system is derived, and applied in particular to Cl^{38} and K^{40}. A.

539.152.1

8318. ELECTRIC-MONOPOLE TRANSITIONS IN ATOMIC NUCLEI. E.L.Church and J.Weneser.
Phys. Rev., Vol. 103, No. 4, 1035-44 (Aug. 15, 1956).

Low-energy electric-monopole or E0 transitions ($\Delta I = 0$, no) proceed solely by internal conversion, with zero units of angular momentum transferred to the ejected electron. Single gamma-ray emission of this multipole order is strictly forbidden. Electric-monopole pair production is possible for transition energies greater than $2mc^2$. It is pointed out that (1) the electric-monopole mode of de-excitation is available between any two equal-parity states of the same spin, zero or otherwise, (2) in such cases, E0 internal conversion may compete favourably with the paralleling magnetic-dipole and electric-quadrupole transitions in heavy nuclei, and (3) monopole matrix elements may be particularly useful in the study of nuclear structure. The relative and absolute conversion properties of electric-monopole transitions have been calculated relativistically, including the effects of the finite nuclear size and bound-state atomic screening. These results have been used to analyse the available experimental data on the $2+ \rightarrow 2+$ transitions in Hg^{198}, Pt^{196} and Pt^{192}, and to determine upper limits for the monopole matrix elements. These upper limits appear appreciably smaller than the values for the matrix elements of well-known monopole transitions of the $0+ \rightarrow 0+$ type. The possible significance of these results is considered with reference to current nuclear models. A.

539.152.1

8319. RELATION BETWEEN NUCLEON DENSITY AND NUCLEAR POTENTIAL. K.A.Brueckner.
Phys. Rev., Vol. 103, No. 4, 1121-4 (Aug. 15, 1956).

The relationship between nuclear density and potential is determined, taking account of the saturating character and the finite range of the two-body forces. The former characteristic alone leads to the nonlinear relation between nuclear density and potential pointed out by Wilets, and accounts for an increase of potential radius over density radius of about 5×10^{-14} cm. The finite-range effect is estimated by using pseudo-potentials to represent the two-body interaction operators generated by the two-body potentials. The combined effects of nonlinearity and finite range give an increase in the r.m.s. potential radius which is very close to that observed experimentally. The fall-off distance of the potential surface predicted is, however, somewhat greater than that empirically determined. It is pointed out that this discrepancy may be removed if proper account is taken of the nonlocal character of the nuclear potential. A.

539.152.1

8320. AN EXAMINATION OF OBSERVED REGULARITIES IN NUCLEAR ENERGY LEVELS. S.R.Broadbent.
Proc. Phys. Soc. A, Vol. 69, Pt 4, 354-5 (April, 1956).

It is suggested that the apparent regularity in position of excited nuclear states such as that reported by Grant (Abstr. 4526/1952) could be fortuitous. A similar behaviour is obtained from a set of nuclear energy levels distributed at random. M.A.Grace

539.152.1

8321. ON THE RELATION BETWEEN HILL–WHEELER'S AND BOHR–MOTTELSON'S DESCRIPTIONS OF THE NUCLEAR COLLECTIVE MODEL. T.Marumori.
Progr. theor. Phys., Vol. 14, No. 6, 608-9 (Dec., 1955).

It is shown briefly that the difference between their descriptions is only that between their representations of the nuclear states except at trivial points. J.J.Phipps

539.152.1

8322. EFFECT OF HARD CORE ON THE BINDING ENERGIES OF H^3 AND He^3. I. T.Kikuta, M.Morita and M.Yamada.
Progr. theor. Phys., Vol. 15, No. 3, 222-36 (March, 1956).

The binding energies of H^3 and He^3 are calculated assuming two-body forces of exponential type with hard cores, radii of which are taken equal for both the spin singlet and the triplet states. The outside potentials are supposed charge-independent, and are chosen so as to fit the nuclear two-body data in the low-energy region. The following results have been obtained concerning the effects of hard core: (1) it diminishes the binding energies of H^3 and He^3 considerably, and (2) the wave function is pushed out so that the Coulomb energy of He^3, which is too large without hard core, is reasonably reduced to the experimental value for the difference between the binding energies of H^3 and He^3. A.

539.152.1

8323. PROPERTIES OF ENERGY SURFACES OF HEAVY NUCLEI. N.N.Kolesnikov.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 889-99 (1956). In Russian.

A detailed study of the properties of the energy surface of heavy nuclei has been carried out for each of the four types of nuclear parity. A more accurate formulation of known empirical laws and of the energy surface parameters is given and it is shown that for given values of the mass number A, the masses are minimal at several different values of Z which depend on the parity of Z. The curvature of the isobar parabolas is independent of the parity of Z and is apparently somewhat larger for nuclei with even values of A. The nature of the shells with N = 126 and Z = 82 has been elucidated. The results are compared with the usual binding energy formulae. A

539.152.1

8324. ON THE STATISTICAL THEORY OF THE ATOMIC NUCLEUS. III. B.K.Kerimov and A.V.Dzhavadov.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 900-14 (1956). In Russian.

For Pt II see Abstr. 1107 (1955). A statistical nuclear model with uniform and non-uniform density distribution of nucleons has been investigated. It is shown that a two-nucleon central interaction potential containing both spin exchange force and ordinary non-exchange repulsive force leads to saturation of the nuclear binding energy and nuclear density. A.

539.152.1

8325. MAGNITUDE OF THE NUCLEAR SPIN–ORBIT INTERACTION. I.I.Levintov.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 987-9 (1956). In Russian.

The ratio of the spin–orbit to central interaction is found to be about the same for a large group of cases: the scattering of 130-315 MeV nucleons by nuclei, He^4–p and He^4–n scattering, the splitting of the levels in O^{17} and Pb^{208}, and the ordering of the shell model levels. G.E.Brown

539.152.1 : 539.172.13

8326. NUCLEAR LEVELS IN Li^6. Yu.L.Sokolov, M.M. Sulkovskaya, É.I.Karpushkina and E.A.Al'bitskaya.
Zh. éksper. teor. Fiz., Vol. 30, No. 6, 1007-12 (1956). In Russian.

Reactions involving the emission of several particles during interaction of fast (energy up to 13.8 MeV) deuterons with Li^6 and Li^7 nuclei were studied by the photographic method. The reactions Li^6 (d, 2d) He^4, Li^6(d; d', p, n) He^4 and Li^7(d; t, d') He^4 which lead to the production of Li^6 excited nuclei were detected. The following nuclear levels were found in Li^6 (with T = 0) E^*_1 = 2.2 MeV; E^*_2 = 4.5 MeV and E^*_3 = 7.5 MeV. A.

539.152.2

8327. THE MAGNETIC MOMENT OF THE 200 keV EXCITED STATE OF ^{19}F. W.R.Phillips and G.A.Jones.
Phil. Mag. (Ser. 8), Vol. 1, No. 6, 576-83 (June, 1956).

This has been measured by observing the influence of an external magnetic field on the directional properties of a γ–γ cascade through this state. The cascade follows the β-decay of O^{19} produced by neutron bombardment of HF. The result, $\mu = +3.50 \pm 0.24$ n.m., assumes that no time-dependent quadrupole interaction is present in the source; the effect of the possible presence of such an interaction is discussed. A.

539.152.2 : 548.7

8328. NUCLEAR QUADRUPOLE LEVELS IN SINGLE CRYSTALS. P.M.Parker.
J. chem. Phys., Vol. 24, No. 5, 1096-102 (May, 1956).

Numerical methods are used to study the behaviour of the energy levels of a nucleus, having non-zero quadrupole momen and spin I = 1 or $\frac{3}{2}$, under the influence of a constant uniform external magnetic field and an electric crystalline field of axial symmetry. These numerical results are of use when experimental conditions are such that perturbation theory cannot be applied in data analysis. A.

539.152.2

8329. DETERMINATION OF THE LONGITUDINAL RELAXATION TIMES FOR MAGNETIC RESONANCE OF ATOMIC NUCLEI IN AN INTENSE HIGH-FREQUENCY MAGNETIC FIELD. S.D.Gvozdover and N.M.Ievskaya.
Zh. éksper. teor. Fiz., Vol. 29, No. 5 (11), 637-44 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 3, 486-92 (May, 1956).

Two methods for determining the longitudinal relaxation time T_1 are treated. The methods are based on the use of the inversion of the dispersion signals observed in an intense high-frequency magnetic field during a change in the constant field and on the use of the change in the time interval which precedes the inversion point. In order to verify the methods, an evaluation of the effect of the intermediate region which connects the resonance region and the region of free relaxation was carried out. Relationships are obtained which allow the determination of the longitudinal relaxation time. In order to confirm the methods experimentally, the dependence of the longitudinal relaxation time on the concentration of paramagnetic ions was measured in aqueous solutions of cupric sulphate and ferric nitrate. A.

539.153

8330. A MODIFICATION OF THE WEIZSÄCKER CORRECTION IN THE STATISTICAL ATOM. P.Gombás.
Ann. Phys. (Leipzig), Vol. 18, No. 1-2, 1-16 (1956). In German.

Through a correction to the kinetic energy, excellent agreement between calculated and experimental energies is reached. G.E.Brown

539.153

8331. THE ORBIT–ORBIT INTERACTION. S.Yanagawa.
Progr. theor. Phys., Vol. 13, No. 5, 559 (May, 1955).

The orbit–orbit interaction between atomic electrons proposed by Trees (Abstr. 8142/1951, 1629/1952) may be accounted for by the Breit Hamiltonian. P.T.Matthews

539.153 : 539.18

8332. ENERGY LEVELS OF π-MESIC ATOMS.
D.J.Thouless.
Proc. Phys. Soc. A, Vol. 69, Pt 3, 280-1 (March, 1956).

In the effect of nuclear absorption on π-mesic energy levels calculated by Brueckner, an intermediate state with two mesons must be considered and the result is quite model-dependent. G.E.Brown

539.153.4

8333. FURTHER REMARKS ON ATOMIC COMPONENT ORBITALS FOR THE CONFIGURATIONS $(1s)^2$ (2s) AND $(1s)^2$ $(2s)^2$. E.Holøien.
Arch. Math. Naturvid., Vol. 53, No. 5, 14 pp. (1956).

Previous theoretical work on simple analytic expressions of atomic component 1s- and 2s- orbitals (Abstr. 5589/1955) is extended to determine the positions of the nodes and to calculate the integral of the square of the difference between the Hartree–Fock function and the approximate orbitals. This integral being an excellent measure of the comparison of the orbitals with the Hartree–Fock function, is only computed for the lithium and beryllium ground states. As expected the results are in good agreement with those previously obtained by energy computations. Explicit energy formulae obtained by using the author's 1s- and 2s-orbitals are given. Available checks of the Hartree–Fock energies are finally provided for by a further approximate computation of some integrals of the difference of the functions. A.

539.155.1 : 537.542

8334. MASS DETERMINATION OF B^{10}, B^{11}, Na^{23}, K^{39} AND K^{41} USING AN ELECTRON-IMPACT ION SOURCE. H.Liebl and H.Ewald.
Z. Naturforsch., Vol. 11a, No. 5, 406-10 (May, 1956). In German.

Describes in some detail an ion source, in which electrons from a heated filament make multiple transits through an ionization chamber. Two ovens for the evaporation of solid substances are provided, to facilitate the examination of mass doublets. The ion source is used in conjunction with a conventional double focusing mass spectrometer, and results are presented for the following mass doublets: $B^{10}H$-B^{11}, $B^{11}H$-C, $B^{10}B^{11}H_2$-Na^{23}, C_3H_3-K^{39} and C_3H_5-K^{41}. A critical comparison with previous results is made. E.A.Ash

539.155.2

8335. THE ISOTOPIC COMPOSITION OF STRONTIUM FROM SEA-WATER AND RUBIDIUM-FREE MINERALS.
H.Ewald, S.Garbe and P.Ney.
Z. Naturforsch., Vol. 11a, No. 6, 521-2 (June, 1956). In German.

The Sr isotope ratios have been measured in sea-water and 9 samples of the minerals: limestone, strontianite and cölestine. The Sr^{86}/Sr^{88} ratio is between 0.1192 and 0.1196 for all samples but the Sr^{87}/Sr^{86} ratio ranges from 0.692 to 0.718, with sea-water having the highest value. An attempt is made to explain this difference in terms of the disintegration of Rb^{87} and the age of the minerals; this is not completely successful. J.M.Hough

539.155.2

8336. INVESTIGATION OF THE ISOTOPIC CONSTITUTION OF LITHIUM. K. Ordzhonikidze and V.Shyuttse.
Zh. éksper. teor. Fiz., Vol. 29, No. 4(10), 479-85 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 3, 396-401 (May, 1956).

Investigations of the separation effects of the isotopes of lithium have been carried out by evaporation of lithium ions from a tungsten surface and by ionization of molecular beams of lithium compounds by an electron beam. In the first case two processes of ionic emission have been discovered: the first process occurs at low anode temperatures with a separation coefficient greater than for free evaporation; the second process takes place at high anode temperatures without separation of the isotopes and provides a simple and accurate method of measuring the relative abundance of the isotopes of lithium. The relative abundance of the lithium isotopes Li^7/Li^6 was found to be 12.47 ± 0.02. A small separation effect of unexplained origin has been found to take place during ionization of the lithium compounds by the electron beam. By means of the method developed by the authors, the relative abundances of the lithium isotopes have been measured for several minerals. A.

539.155.2

8337. THE UPTAKE AND ISOTOPIC ENRICHMENT OF LITHIUM BY YEAST. H.J.M.Bowen.
J. nuclear Energy, Vol. 2, No. 4, 255-63 (June, 1956).

The potassium normally present in baker's yeast can be largely replaced by lithium. Lithium-rich yeasts are not distinguished microscopically from normal yeasts; the lithium can be removed very rapidly by incubating the yeast with potassium salts. If the yeast is incubated with mixtures of lithium and potassium, the Li/K ratio inside the yeast is always much smaller than in the medium. An empirical relation between the two ratios is in marked disagreement with the law of mass action. Lithium can be enriched in its lighter isotope when it is taken up by yeast. This isotope appears to enter and leave the yeast cell more readily than Li^7. It is suggested that biologically enriched Li^6 may be discovered in nature. A.

539.155.2 : 533.15

8338. A COUNTERCURRENT GASEOUS DIFFUSION PROCESS; THEORY OF THE SEPARATION AT EQUILIBRIUM. J.A.McMillan.
Z. Naturforsch., Vol. 11a, No. 4, 284-5 (April, 1956).

An experimental device for obtaining a gaseous diffusion countercurrent process is proposed. The theory of the separation at equilibrium for a binary isotopic mixture is developed on the basis of the transport up the tube, the total, and the desired, molecule transverse transport. The solution is given for any value of the relative abundances. A.

539.155.2 : 536.48

8339. ENRICHMENT OF HELIUM WITH ISOTOPE He^3. V.P.Peshkov.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 850-4 (1956). In Russian.

A unit for enrichment of helium with the He^3 isotope is described. The thermomechanical effect and rectification are used in the apparatus. A possible degree of enrichment and the extraction of He^3 by thermo-osmosis are discussed. A.

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16.08

8340. THE CONTRIBUTION OF NEUTRONS TO THE BACKGROUND OF COUNTERS USED FOR ^{14}C AGE MEASUREMENTS. H. de Vries.
Nuclear Physics, Vol. 1, No. 6, 477-9 (May, 1956).

Evidence is given that neutrons produced by cosmic radiation produce an important fraction of the residual background of counters used for C^{14} age measurements. Neutron monitoring is essential in order to check irregular variations of the neutron flux, as for instance produced by solar flares. During the solar flare of Feb. 23 the average background for the whole night was 2.5 times normal. A.

539.163 : 550.422

8341. REPORT ON THE OCCURRENCE OF TECHNETIUM ON THE EARTH'S CRUST. G.E.Boyd and Q.V.Larson.
J. phys. Chem., Vol. 60, No. 6, 707-15 (June, 1956).

A search for primordial technetium has failed to reveal any traces of this element in a variety of terrestrial substances, nor are recent reports of the occurrence of technetium in molybdenite and in yttrotantalite confirmed. Post-war nuclear chemical researches have shown that technetium possesses no beta-stable nuclear species, although three long-lived isotopes have been established. Both Tc^{97} and Tc^{99} possess half-lives of less than one million years and hence, if initially present, would have disappeared in the approximately 4.5×10^9 years since the formation of the Earth. The possibility for discovering primordial technetium has therefore appeared to depend on whether or not the half-life of long-lived Tc^{98} exceeds 10^8 years. Results from chemical studies with gram quantities of fission product Tc^{99} suggest that technetium should exhibit a strong geochemical coherence with rhenium, which is known to be siderophile and chalcophile. Extremely sensitive methods for the detection of sub-microgram quantities were developed. The most reliable method is that of isotopic dilution using Tc^{99} and mass spectrometric analysis. The neutron activation method based on the formation of 6.0 hr Tc^{99m} from Tc^{98} although more sensitive, is subject to interference, particularly by the Tc^{99} (n, n') 6.0 hr Tc^{99m} reaction. The negative result obtained in this search appears to be supported by a recent study which indicates a fairly positive disproof of the existence of technetium in the Sun, and by the preliminary finding in that the half-life of Tc^{98} is approximately 10^5 years. A.

539.163

8342. HALF-LIVES AND ALPHA ENERGIES OF Cm^{248} AND Cm^{246}. J.P.Butler, T.A.Eastwood, H.G.Jackson and R.P.Schuman.
Phys. Rev., Vol. 103, No. 4, 965-6 (Aug. 15, 1956).

The new isotope Cm^{248}, the daughter of Cf^{252}, has been separated from a sample of californium. Cm^{248} decays by the emission of a 5.054 ± 0.015 MeV α-particle with an alpha half-life of $(4.7 \pm 0.4) \times 10^5$ years. The spontaneous fission half-life of Cm^{248} was found to be $(4.6 \pm 0.5) \times 10^6$ years. Cm^{246} was also observed in the curium daughters isolated from the californium sample; the Cm^{246} decays by the emission of a 5.373 ± 0.010 MeV α-particle with a half-life of 6620 ± 320 years. A.

539.163

8343. CONVEYOR BELT METHOD FOR STUDYING SHORT-LIVED ACTIVITIES: Ag^{108}, Ag^{110} AND In^{116}. M.C.Joshi and B.V.Thosar.
Proc. Indian Acad. Sci. A, Vol. 43, No. 5, 255-64 (May, 1956).

A technique suitable for half-lives in the range from a second to several minutes is described. The activity is induced at one point in the sample spread over a moving, endless conveyor belt and is studied at another point. The equilibrium counting rate then depends on the speed of the belt. The activity of 22 sec Ag^{110} and that of 2.3 min Ag^{108} have been studied. The maximum energies of beta-ray groups were determined from absorption curves. Gamma-ray energies were obtained with a scintillation spectrometer. It is shown that in favourable cases, when two short-lived activities are present, the shorter-lived one can be filtered out by adjusting the speed of the belt. A.

539.163.

8344. DECAY CONSTANTS OF K^{40} AS DETERMINED BY THE RADIOGENIC ARGON CONTENT OF POTASSIUM MINERALS. G.W.Wetherill, G.J.Wasserburg, L.T.Aldrich, G.R.Tilton and R.J.Hayden.
Phys. Rev., Vol. 103, No. 4, 987-9 (Aug. 15, 1956).

It is shown that the potassium–argon age of young minerals depends almost linearly on the decay constant for electron capture in K^{40} and is very insensitive to the decay constant for beta emission. This fact permits calculation of λ_e by comparing the concordant uranium–lead age of cogeneti uraninite with A^{40}/K^{40} ratios found in young samples of mica. It is found that $\lambda_e = (0.557 \pm 0.026) \times 10^{-10}$ yr^{-1}. Similar comparisons with older mica samples indicate that satisfactory agreement with the uraninite ages are obtained by use of this value of λ_e together with $\lambda_\beta = (0.472 \pm 0.05) \times 10^{-9}$ yr^{-1}. It is concluded that there is no conflict between the decay constant inferred by this geological method and those found by direct counting experiments. A

539.163.

8345. BETA DECAY OF ^{161}Tb AND LOW-LYING LEVELS IN ^{161}Dy. A.Bisi, S.Terrani and L.Zappa.
Nuclear Physics, Vol. 1, No. 6, 425-32 (May, 1956).

The β- and γ-radiations from Tb^{161} were analysed by means of a scintillation spectrometer, a proportional counter a β-ray spectrometer and γ-γ and β-γ coincidence techniques γ-Rays were observed at energies 25.9 ± 0.2, 49 ± 2, 77 ± 2 k The end-point of the β- spectrum occurs at 500 ± 3 keV. The half-life was found to be $T_{1/2} = 6.9 \pm 0.1$ d. A decay scheme is proposed. A

539.163.

8346. DECAY OF Gd^{153}. S.K.Bhattacherjee and S.Raman.
Nucleon Physics, Vol. 1, No. 7, 486-98 (June, 1956).

The decay by electron capture of Gd^{153} (half-life 236 days is studied with a coincidence scintillation spectrometer. Two gamma-rays are observed with energies 72 ± 8 keV and $100 \pm$ 4 keV and relative intensities of 7 : 100. Both these gamma-rays are coincident with K X-rays of Eu. From the coincidence data the K-shell conversion coefficient of the 100 keV gamma transition has been determined to be 0.67 ± 0.12; the comparison with theory then leads to assigning this gamma-ray predominantly to a magnetic dipole transition. From the experimental L/K capture ratio the energy involved in the capture process is estimated. The results show that the leve in Eu^{153} which are reached by the capture decay of Gd^{153} are not identical with the levels that were observed in Coulomb excitation of Eu. A decay scheme is proposed for Gd^{153}. A

539.163

8347. DECAY SCHEME OF La^{138}. W.Turchinetz and R.W.Pringle.
Phys. Rev., Vol. 103, No. 4, 1000-3 (Aug. 15, 1956).

The methods of scintillation spectroscopy have been applied to the naturally occurring radionuclide La^{138}. It is shown that La^{138} emits gamma radiation of energies $1.43 \pm$ 0.01 and 0.81 ± 0.01 MeV. Coincidence studies show that the 1.43 MeV radiation is correlated in time with an observed Ba K X-ray (32 ± 1 keV), but not with the 0.81 MeV gamma-ray. A decay scheme is proposed in which La^{138} undergoes electron capture to the first excited level of Ba^{138} at $1.43 \pm$ 0.01 MeV with a partial half-life of $(2.1 \pm 0.1) \times 10^{11}$ years a an L/K ratio of 1.4 ± 0.25, and negatron decay to an excited level of Ce^{138} at 0.81 MeV with a partial half-life of $(2.4 \pm 0.$ $\times 10^{11}$ years. Consideration of beta-decay systematics suggest that in each case the transition energy is low. The total half-life is estimated to be $(1.0 \pm 0.1) \times 10^{11}$ years.

539.163.

8348. THE DECAY OF THE ISOMERIC STATE OF ^{193}Tl. P.S.Fisher and V.Knapp.
Proc. Phys. Soc. A, Vol. 69, Pt 7, 541-7 (July, 1956).

The gamma-rays from Tl^{198} and Tl^{198m} have been examined with a sodium iodide spectrometer singly and in coincidence. Radiation at 637, 588 and 411 keV, decaying with a period of 1.8 hr, is associated with transitions in Hg^{198} following a 60% K-capture branch from the isomeric state Tl^{198m}. Tentative spins and parities are assigned. A.

539.164

8349. HIGHLY EXCITED ROTATIONAL STATES OF SOME NUCLEI. INTENSITY OF α DECAY TO ROTATIONAL EXCITED LEVELS. L.L.Goldin, G.I.Novikova and E.F.Tretyakov.
Phys. Rev., Vol. 103, No. 4, 1004-8 (Aug. 15, 1956).

The α spectra of Pu^{240} and U^{233} have been investigated. A more precise value $(8.5 \pm 1.5) \times 10^{-4}$, for the intensity of the Pu^{240} α line corresponding to the transition to the $4+$ level of the daughter nucleus has been obtained. New α lines corresponding to the levels with energies 164 keV (0.07 ± 0.04%) and 237 keV (0.04 ± 0.02%) have been found in the α spectrum of U^{233}. Thus, successive transitions to rotational levels starting from the ground level (spin 5/2) and up to the level with spin 15/2 have been observed. Earlier results on the α decay of Am^{241} (on the population of the levels between 5/2 and 13/2) are used in the discussion. The α-line intensities are compared with available theoretical formulae. A.

539.165

8350. FIRST FORBIDDEN NONUNIQUE BETA TRANSITIONS IN Re^{186}. F.T.Porter, M.S.Freedman, T.B.Novey and F.Wagner, Jr.
Phys. Rev., Vol. 103, No. 4, 921-42 (Aug. 15, 1956).

The beta spectrum of the main inner group of 89.0 hr Re^{186} ($E_0 = 934.3 \pm 1.3$ keV; 24% of total betas; log ft = 8.0) has been magnetically analysed in coincidence with the 137.2 keV gamma. The observed spectrum does not have the allowed shape nor the unique ($\Delta I = 2$, yes) shape; its spectrum shape correction factor increases about 18% from 150 keV to 900 keV. Subtraction of this spectrum, weighted with its measured relative abundance, from the composite spectrum, produces the spectrum of the ground state transition ($E_0 = 1071.5 \pm 1.3$ keV; 76% of total betas; log ft = 7.68). Its similarly nonallowed, nonunique shape factor increases by about 22% from 150 keV to 1050 keV. Both transitions are interpreted as first forbidden ($\Delta I = 1$, yes); Re^{186} is assigned a ground state spin and parity 1(−). A theoretical parametric fitting of these spectra with the combination of scalar and tensor beta interactions is demonstrated; the limited ranges of the fitting parameters, which are functions of the nuclear matrix elements, are obtained. A comparison is presented between the theoretical fittings of the beta spectrum of the inner group and of the beta–gamma angular correlation. Pursuant to these studies on Re^{186} values were obtained for the maximum beta energies, gamma energies, conversion coefficients, half-life, and branching ratios, particularly of the approximately 0.1% abundant 307 keV beta group. A.

539.165 : 539.166

8351. BETA–GAMMA DIRECTIONAL CORRELATION IN Re^{186}. T.B.Novey, M.S.Freedman, F.T.Porter and F.Wagner, Jr.
Phys. Rev., Vol. 103, No. 4, 942-8 (Aug. 15, 1956).

The directional correlation between the nonunique first forbidden 934 keV beta group and the 137 keV E2 gamma transition in the decay of Re^{186} has been measured as a function of beta energy above 150 keV. Analysis of the experimental data included a correction for the finite energy resolution of the anthracene crystal scintillation spectrometer, which takes into account the effect of the backscattering of electrons from the crystal. The differential anisotropy increases with increasing beta energy to 0.158±0.006. The directional correlation $W(\theta) = 1 + (0.105 \pm 0.003) \cos^2\theta$ for beta energies of 257-934 keV, with no evidence for a $\cos^4\theta$ term, in agreement with theoretical expectation for a first forbidden beta transition. Limited ranges for the ratios of the nuclear matrix elements governing the beta decay were obtained by comparison with theory, assuming the following: the spin and parity sequence $(1-, 2+, 0+)$; the beta interaction mixture scalar plus tensor; point nuclear charge. Higher order terms in $2\rho/\alpha Z$ were included. A.

539.165

8352. PROBABLE ABSENCE OF K-CAPTURE IN THE DECAY OF LEAD-205. R.H.Herber, T.T.Sugihara, C.D.Coryell, W.E.Bennett and J.R.Huizenga.
Phys. Rev., Vol. 103, No. 4, 955-6 (Aug. 15, 1956).

A number of experiments designed to detect the K-capture decay of Pb^{205} are discussed. No K X-ray activity which could be ascribed to Pb^{205} was observed in deuteron-bombarded natural lead or neutron-irradiated 25.7% Pb^{204}. From these results, the L-capture half-life of Pb^{205}, and its absence in natural lead, it is concluded that Pb^{205} does not decay by K-capture with a half-life in the range $2 \text{ sec} < t_{1/2} < 10^{10}$ years. A.

539.165

8353. CORRECTED MAXIMUM β-ENERGIES OF POSITRON-EMITTERS. A.H.W.Aten, Jr.
Physica, Vol. 22, No. 4, 288 (April, 1956).

Absorption measurements on the positron spectrum of the following nuclides lead to new values for the maximum positron energies: Ga^{65} (1.9 ± 0.2 MeV), Ga^{67} (2.9 ± 0.3 MeV), As^{70} (2.2 ± 0.3 MeV), $Se^{73?}$ (1.7 ± 0.2 MeV) and Sb^{116} (2.3 ± 0.3 MeV). M.A.Grace

539.165

8354. ATTENUATED ANGULAR CORRELATIONS BETWEEN K-CONVERSION ELECTRONS IN ^{197}Hg. E.Breitenberger.
Proc. Phys. Soc. A, Vol. 69, Pt 7, 566-73 (July, 1956).

The angular correlation between the successive K-conversion electrons from the de-excitation of 23-hr Hg^{197} has been investigated in an attempt to determine the limitations of correlation work with conversion electrons in cases of cascades with a long-lived intermediate state. Sources prepared by embedding the activity carrier-free in thin aluminium films exhibited consistent behaviour; the second-order term of the correlation function was attenuated 18 ± 5% below the theoretical value. It is concluded that in cases of this type the necessity of using very thin sources, the limited choice of source backing materials, and the nuclear recoil accompanying the first conversion transition do not generally allow one to avoid all perturbative effects. An oxidized source exhibited complete "loss of correlation memory". An explanation of this phenomenon in terms of non-stationary hyperfine-structure interaction is proposed. If the highly charged ions left behind by the first conversion transition have a lifetime similar to that of the intermediate nuclear state, as can happen in a badly conducting course, the progressing neutralization affects the nuclear precession in a random way and thus leads to isotropy. A.

539.165

8355. ELECTRON SPECTRA OF Pu^{239}, Pu^{240} AND Pu^{241}. K.N.Shlyagin.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 817-23 (1956). In Russian.

A 180° magnetic beta-spectrometer has been used to study the electron spectra of two plutonium samples containing different amounts of Pu^{239}, Pu^{240} and Pu^{241}. By using thin celluloid films and thin radioactive sources the spectra could be measured starting from ~ 1 keV. Gamma-transition energies of U^{235} and U^{236} nuclei were determined from the electron conversion lines. The values for U^{235} are 3(?), 12.5, 38.3, 50.8, 117(?) keV and for U^{236} — 44.6 keV. The shape of the measured beta spectrum of Pu^{241} indicates that the spectrum is an allowed one, the upper limit being E_0 = 20.8 keV. A.

539.165.2 : 539.152.1

8356. ON EQUALLY ALLOWED β-TRANSITIONS. B.S.Dzhelepov and L.K.Peker.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 6, 626-9 (1956). In Russian.

An attempt to check the validity of the usual description of a β-transition as allowed or forbidden according to the difference in angular momentum and parity of the two states. Tabulates values of log τf for 21 pairs of β-transitions of the types $0^+ \leftarrow X \rightarrow 0^+$ or $0^+ \rightarrow X \rightarrow 0^+$ in which each transition of the pair is equally allowed or forbidden. It is found (except in one case) that pairwise the values of log τf are roughly equal. The following rule is formulated: "If one of the two 0^+-nuclei has a filled shell of protons or neutrons, log τf will be smaller for the transition to it than for the transition to the other 0^+-nucleus". This rule is discussed in terms of the hypothesis of Wilets et al. (Abstr. 683/1954) that the deformation coefficient of isotopes with odd A is somewhat less than that of isotopes with A even. J.M.Radcliffe

539.165.2

8357. THE LONG β-LIFETIME OF ^{14}C AND THE ^{14}N SPECTRUM. J.P Elliott.
Phil. Mag. (Ser. 8), Vol. 1, No. 6, 503-17 (June, 1956).

These are explained using a small tensor force in addition to the usual central and spin–orbit forces. The γ-decay branching ratio of the 3.95 MeV level of N^{14} is predicted and also the nucleon reduced widths for the low levels of N^{14} and N^{15}. A.

539.165.2

8358. PROPOSAL FOR EXPERIMENTS FOR DETERMINATION OF BETA-DECAY INTERACTION AND THEORY OF TRIPLE CASCADE TRANSITION. M.Morita.
Progr. theor. Phys., Vol. 15, No. 5, 445-60 (May, 1956).

Four new kinds of experiments on angular correlation in 3_-, $5_-(\beta$ 1st) or $6_+(\beta$ 2nd) $4_+(\gamma_1\ 2)\ 2_+(\gamma_2\ 2)\ 0_+$ are proposed so as to determine definitely ST (or VT) as the β-decay interaction. Some other decay schemes also useful for this purpose are discussed. Various angular correlation functions are given for the successive triple transitions of α, β, γ rays and also of the other kind of particles. A.

539.166

8359. ANGULAR CORRELATIONS IN Ti^{48}. C.F.Coleman.
Phys. Rev., Vol. 103, No. 3, 647-51 (Aug. 1, 1956).

The angular correlations of the (0.99, 1.32) MeV and (2.23, 0.99) MeV gamma-ray cascades in Ti^{48} have been measured and are consistent with spin assignments to the ground, 0.99, 2.31 and 3.22 MeV states of 0, 2, 4 and 4, respectively. Taken with these results, the measured values of the two polarization-direction correlations for the (0.99, 1.32) MeV cascade rule out most spin assignments for the first three levels which require a mixed 1.32 MeV transition, and show that these levels must all have even parity. The mean lifetime of the 0.99 MeV level was found to be $< 2 \times 10^{-11}$ sec. A.

539.166.08

8360. A SIMPLE WIDE-RANGE GAMMA DOSE-RATE METER. K.E.G. Perry and C.C.H.Washtell.
Nuclear Pwr, Vol. 1, No. 1, 17-19, 28 (May, 1956).

This dose-rate meter, which covers in a single range 10 mR/hr to 10 000 R/hr has been designed for Health Physics purposes. The circuit employs an electrometer pentode as the logarithmic element in a d.c. amplifier to measure the current in an ionization chamber, the meter presentation being on a logarithmic scale. A.

539.166.2

8361. CORRELATION OF POLARIZATION AND DIRECTION OF EMISSION OF GAMMA QUANTA FROM Co^{60} AND Na^{24}. I.V.Éstulin, V.S.Popov and F.E.Chukreev.
Zh. éksper. teor. Fiz., Vol. 30, No. 6, 1052-7 (1956). In Russian.

An arrangement is described for measurement of the correlations of polarization and direction of emission of cascade quanta. After experimental determination of the polarization sensitivity of the apparatus it was used to measure the quanta from Co^{60} and Na^{24}. Positive parity of the first two excited states of Ni^{60} and Mg^{24} has been demonstrated. A.

539.166.83

8362. INDICATIONS FOR A STRONG INFLUENCE OF THE NUCLEAR SIZE ON MAGNETIC DIPOLE CONVERSION COEFFICIENTS. A.H.Wapstra and G.J.Nijgh.
Nuclear Physics, Vol. 1, No. 4, 245-58 (March, 1956).

An analysis of the conversion coefficients of the 279 keV transition in Tl^{203} indicates that the theoretical conversion coefficients as computed by Rose et al. disagree with the experimental data. In this case as well as in those of other transitions in heavy nuclei a better agreement is obtained if the theoretical K and L_I shell conversion coefficients for M1 transitions are lowered by about 40%. Probably this is due to the fact that the finite size of the nucleus was not taken into account in the theoretical calculations. The data about L_{II} conversion are controversial. A.

539.166.83 : 537.56

8363. MULTIPLE IONISATION IN XENON FOLLOWING INTERNAL CONVERSION. A.H.Snell and F.Pleasonton.
Phys. Rev., Vol. 102, No. 5, 1419-20 (June 1, 1956).

Magnetic analysis has been applied to determine the charge states of Xe^{131} resulting from the isomeric nuclear transition of Xe^{131m}. The charge 1 state corresponds to the emission of the original conversion electron and it, in fact, only contributes 0.6%. The normal occurrence appears to be a complete depopulation of the outer electron shell giving a charge state of 8. There is a real intensity in the charge spectrum out to Z = 29. D.J.Prows

539.166.835

8364. MULTIPLE PHOTON PRODUCTION BY ELECTRON PAIR ANNIHILATION IN FLIGHT. J.Joseph.
Phys. Rev., Vol. 103, No. 2, 481-8 (July 15, 1956).

Starting with the Feynman–Dyson S-matrix, the two leading terms in the high-energy expansion of the cross-section for multiple photon production by electron pair annihilation in flight are calculated. In the extreme relativistic limit, when $\ln(E_+/m) \gg 1$, where E_+ is the positron energy in the laboratory system, the result reduces to that previously obtained by Gupta. The first four terms in the high-energy expansion of the three-photon production cross-section were also calculated. Gupta obtained the leading term only and found a discrepancy between σ_3 and σ_n for $n = 3$ by a factor $\frac{3}{2}$. This discrepancy is removed. For the sake of simplicity, Gupta assumed that the principal contributions to the cross-section come from (1) low energy photons and (2) small scattering angles. All these assumptions are proved valid. The possibility of observing multiple photon production is discussed. A

NUCLEAR REACTIONS 539.17

539.17

8365. APPLICATION OF ADIABATIC FUNCTIONS TO $N^{14} + N^{14}$ REACTIONS. M.E.Ebel.
Phys. Rev., Vol. 103, No. 4, 958-61 (Aug. 15, 1956).

Nucleon tunnelling in reactions of the type $N^{14}(N^{14}, N^{15})N^{15}$ and $N^{14}(N^{14}, C^{13})O^{15}$ is calculated by using adiabatic wavefunctions constructed by the well-depth eigenfunction method. The procedure is applicable only if resonance effects in the transfer do not enter; in this case the results are shown to b

quivalent with those obtained in the more detailed considera-
ons of the energy matrix method. A.

539.172

66. ON THE CORRELATION METHOD FOR THE DETER-
INATION OF THE ABSOLUTE YIELD OF NUCLEAR REAC-
IONS. V.I.Gol'danskiĭ and M.I.Podgoretskiĭ.
h. éksper. teor. Fiz., Vol. 29, No. 5 (11), 559-71 (1955).
Russian. English translation in: Soviet Physics JETP
ew York), Vol. 2, No. 3, 441-50 (May, 1956).

An examination of the statistical method of investigating
clear transformations and of determining their absolute yield
d mechanism. The method is based on measurement of the
agnitude of the correlation function between the observed
ansformations of various types. The correlation function and
s dispersion have been calculated (in the absence and in the
esence of background noise), and the question of the accuracy
the method has been examined. The well-known method of
incidences is a special case of the correlation method, which
also applicable for longer time intervals between related
ansformations at high radiation intensities. A.

539.172

67. NEUTRINO INDUCED DISINTEGRATION OF
EUTERONS. A.B.Govorkov.
h. éksper. teor. Fiz., Vol. 30, No. 5, 974-5 (1956). In
ussian.

The tensor coupling in β-decay could be obtained by
easuring $d + \nu \rightarrow n + n + e^+$ where d is the deuteron and ν,
antineutrino. Evaluation shows this cross-section to be
order of magnitude smaller than the cross-section for
sorption of antineutrinos by protons. G.E.Brown

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See
so under "Cosmic rays". Decimal classification 537.591.8

539.172

68. CAPTURE OF K^--MESONS IN DEUTERIUM AND
TERACTION OF HYPERONS WITH NUCLEONS. L.B.Okun'
d M.I.Smushkevich.
h. éksper. teor. Fiz., Vol. 30, No. 5, 979-81 (1956). In
ssian.

Under the assumption of spin ½ for the K-meson, the
nplitude for such processes as $K^- + p \rightarrow \Sigma^- + \pi^+$ can be
itten $A = a + b.\sigma$. Conclusions are drawn about a and b
suming various spins and parities of the K-meson.
G.E.Brown

539.172.13

69. ELASTIC SCATTERING OF PROTONS AT 31.5, 20,
ND 14.5 MeV. B.B.Kinsey and T.Stone.
hys. Rev., Vol. 103, No. 4, 975-82 (Aug. 15, 1956).

A survey of the differential cross-sections for the elastic
attering of protons has been made for protons of 31.5, 20,
d 14.5 MeV. The angular distribution shows well-developed
axima and minima only for nuclei of intermediate atomic
eight. For heavy nuclei, the diffraction effect is destroyed
the Coulomb scattering. With 31.5 MeV protons, the first
inimum disappears for nuclei heavier than Zr; with 20 MeV
otons, for nuclei heavier than V. In light nuclei, the maxi-
a and minima are progressively obliterated as the mass
mber is reduced and the energy is increased. In the main,
e angular distribution changes smoothly from one nucleus to
nother, the cross-sections at the maxima increasing as the
urth power of the nuclear radius. However, these cross-
ections are not proportional to the energy, as would be ex-
ected from elementary diffraction theory. For intermediate
uclei, these cross-sections are nearly independent of the
nergy; for nuclei from O to Mg rise to a maximum near
0 MeV, and for light nuclei, they fluctuate in a less regular
anner. A.

539.172.13

8370. ANGULAR DISTRIBUTION OF DEUTERONS FROM $^9Be(p,d)^8Be$. II. (SUPPLEMENT). J.Dąbrowski and J.Sawicki.
Acta phys. Polon., Vol. 15, No. 1, 3-4 (1956).

For Pt II see Abstr. 6892/1956. Discusses recent results of J.B.Reynolds and K.G.Stauding on the 16.5 MeV proton $Be^9(p,d)Be^8$ reaction. A.

539.172.13

8371. NUCLEAR LEVELS IN S^{32}, S^{34}, Cl^{35}, AND Cl^{37}.
P.M.Endt, C.H.Paris, A.Sperduto and W.W.Buechner.
Phys. Rev., Vol. 103, No. 4, 961-4 (Aug. 15, 1956).

Barium-chloride targets have been bombarded with protons accelerated by an electrostatic generator to an energy of 7.04 MeV. Charged reaction products (alpha-particles and elastically and inelastically scattered protons) were observed at 90° and 130° to the proton beam with a high-resolution magnetic analyser. The following ground-state Q values have been measured: $Cl^{35}(p,\alpha)S^{32}$, $Q = 1.863 \pm 0.008$ MeV; $Cl^{37}(p,\alpha)S^{34}$, $Q = 3.026 \pm 0.008$ MeV. Levels were observed in S^{32} at 2.237, 3.780, 4.287, 4.465 and 4.698 MeV; in S^{34} at 2.127, 3.302, 3.915, 4.073, 4.114, 4.621, 4.685 and 4.876 MeV; in Cl^{35} at 1.221, 1.763, 2.645, 2.695, 3.006, (3.165), 4.058, 4.113 and 4.174 MeV; in Cl^{37} at 0.838, 1.728, (3.087) and (3.105) MeV. A.

539.172.13

8372. SPECIAL STUDY OF THE 7.6 MeV LEVEL OF C^{12}.
J.Catalá, E.Villar and A.Bonet.
An. Real Soc. Españ. Fís. Quím., Vol. 52(A), No. 3-4, 93-8 (March-April, 1956). In Spanish.

The angular distribution of inelastically scattered deuterons corresponding to the 7.6 MeV excited level in the C^{12} nucleus is calculated in the centre-of-mass system, from results obtained by photographic methods. The total scattering cross-section is given as 47 ∓ 5 millibarns. J.J.Phipps

539.172.13

8373. ANGULAR DISTRIBUTIONS OF SOME INELASTICALLY SCATTERED DEUTERON GROUPS FROM ^{27}Al.
S.Hinds and R.Middleton.
Proc. Phys. Soc. A, Vol. 69, Pt 4, 347-9 (April, 1956).

Magnetic analysis was used in the study of the deuteron groups inelastically scattered by Al^{27} at a bombarding energy of 9 MeV. Angular distributions were measured for the groups leading to the 2.23, 2.75 and 3.04 MeV levels. These are compared with the theoretical predictions of Huby and Newns (Abstr. 4598/1952) based on a stripping mechanism.
M.A.Grace

539.172.13

8374. DEUTERON-DEUTERON REACTION AT HIGH ENERGY. Y.Nishida.
Progr. theor. Phys., Vol. 14, No. 5, 495-6 (Nov., 1955).

The differential cross-section for the process $d + d \rightarrow H^3 + p$ is calculated and discussed. P.Rothwell

539.172.13

8375. STUDY OF THE REACTIONS $_6C^{12}(d,p)_6C^{13}$ AND $_8O^{16}(d,p)_8O^{17}$. F.Alba A., T.A.Brody, A.Fernández, M.Mazari, V.Serment and M.Vásquez B.
Rev. Mexicana Fís., Vol. 4, No. 4, 207-23 (Oct., 1955). In Spanish.

Angular distributions of (d, p) reactions on oxygen and carbon at energies between 1 and 2 MeV are obtained and in some cases are found to differ widely from Butler's theory at resonance energies. A.

539.172.13 : 539.185

8376. NEUTRON SPECTRA PRODUCED BY BOMBARDING LIGHT NUCLEI BY 14 MeV DEUTERONS. G.F.Bogdanov, N.A.Vlasov, S.P.Kalinin, B.V.Rŷbakov and V.A.Sidorov.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 981-3 (1956). In Russian.

Differences in yields between the reaction T + d and He^3 + d indicate that in addition to deuteron disintegration, a 22 MeV excited level of He^4 aids the former reaction. No corresponding excited level is found in Li^4, indicating that the level has T = 0. G.E.Brown

539.172.13

8377. RELATION BETWEEN STRIPPING AND FORMATION OF COMPOUND NUCLEI IN REACTIONS INVOLVING DEUTERONS. Yu.A.Nemilov, I.I.Zherebtsova and B.L.Funstein. Zh. éksper. teor. Fiz., Vol. 30, No. 6, 1013-16 (1956). In Russian.

From a comparison of the yields of final nuclei produced in the $Mg^{26}(d,p)$, $Mg^{26}(d,\alpha)$, $Al^{27}(n,p)$ and $Al^{27}(n,\alpha)$, processes, the ratio of the probabilities of stripping and compound nucleus formation is estimated for the $Mg^{26}(d,p)Mg^{27}$ reaction. It is found that the ratio of the stripping cross-section to the compound nucleus formation cross-section as a function of the deuteron energy reaches a maximum value of about 8-9 at a deuteron energy of 1-2 MeV. A.

539.172.3

8378. A SIMPLE NUCLEAR MODEL FOR ^{7}Li AND ITS USE IN INVESTIGATING THE REACTION $^7Li(\gamma, ^3H)^4He$. W.Czyż.
Acta phys. Polon., Vol. 15, No. 2, 129-142 (1956).

For computing the total and differential cross-sections for the reaction $Li^7(\gamma, H^3)He^4$, a "two-body" nuclear model was used for Li^7. It has been assumed for this model that the Li^7 nucleus can be regarded as a compound system composed of a triton and α-particle rotating around common centre of mass. The cross-section curve so obtained agrees with the results obtained experimentally if one assumes that the forces due to the interaction of the triton with the α-particle are repulsive in the D state. A.

539.172.3

8379. FAST PHOTONEUTRONS FROM BISMUTH. F.Ferrero, A.O.Hanson, R.Malvano and C.Tribuno.
Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 418-29 (Aug., 1956).

The excitation functions for fast photoneutrons from bismuth are observed with (n, p) detectors. These indicate that the fast neutrons are produced predominantly by photons in the region of the giant resonance giving further experimental evidence that the giant resonance can be attributed to strong individual particle transitions rather than a collective type of photon absorption resulting in a general nuclear heating. The experimental angular distribution of the fast neutron component from the giant resonance can be represented by a value of B/A of 0.9 ± 0.1 in agreement with that expected for shell model transitions. The relative number of fast neutrons was found to be about 7% of the total neutron yield. This is consistent with the idea that individual neutrons are excited from upper closed shell levels to levels in the continuum if one takes account of the interaction of the neutrons in these states with the rest of the nucleus, as in the model of Feshbach, Porter and Weisskopf. A.

539.172.3

8380. ANISOTROPIC PHOTOFISSION. E.J.Winhold and I.Halpern.
Phys. Rev., Vol. 103, No. 4, 990-1000 (Aug., 15, 1956).

The angular distribution of photofission fragments with respect to the direction of a high-energy X-ray beam has been found to be anisotropic. The distribution seems to be of the same form, $a + b \sin^2\theta$, in a large variety of situations. The ratio of b to a depends on the energy of the photons producing the fission, on the particular fissionable target being irradiated, and on the particular fission fragments being observed. The photofission excitation curve is compared with the (γ, n) excitation curve in the energy region near the fission threshold where the fission anisotropy seems to be largest. Recent attempts to develop a theory of anisotropic fission are briefly discussed. A.

539.172.3

8381. PHOTONEUTRON YIELDS FOR INTERMEDIATE AND HEAVY NUCLEI. B.I.Gavrilov and L.A.Lazareva.
Zh. eksper. teor. Fiz., Vol. 30, No. 5, 855-61 (1956). In Russian.

The photoneutron yields at various maximal gamma-bremsstrahlung energies lying between the threshold value of the (γ, n)-reaction and E_{max} = 27 MeV were measured. The dependence of the photoneutron cross-sections on the photon energy was determined by the "photon difference" method on the basis of the photoneutron yield curves of ten elements (copper, zinc, cadmium, iodine, tantalum, gold, thallium, bismuth, thorium, uranium). A

539.172.

8382. DETERMINATION OF ABSOLUTE CROSS-SECTION OF (n, p) REACTION IN S^{32}. N.K.Saha and L.K.Rangan.
Indian J. Phys., Vol. 30, No. 2, 80-90 (Feb., 1956).

This was determined by measuring the activity of P produced by fast neutrons from a 95 mg (Raα + Be) source, under cylindrical geometry. The various corrections involved are taken into account. The counter efficiency is determined as (4.7 ± 0.5)% by means of a calibrated end-window counter and a thin layer of chemically separated radiophosphorus of high specific activity. An average value of $\sigma_{n,p}$ = 150 ± 37 millibarns is obtained, which compares reasonably well with the estimated value from other workers' results. A

539.172

8383. SUCCESSIVE NEUTRON CAPTURE IN Tb^{159}. R.R.Smith, S.D.Reeder and R.H.Lewis.
J. chem. Phys., Vol. 25, No. 3, 502-4 (Sept., 1956).

The presence of a 6.8 day activity having a chemical nature similar to or identical with that of terbium has been observed in a sample of Tb_4O_7 irradiated in a high neutron flu in the Materials Testing Reactor. This activity is believed to be that of Tb^{161} formed by secondary neutron capture in Tb^{159}. Measurements of the relative beta intensities of the first and second-order species have been made and lead to a value of 525 ± 100 barns for the pile neutron absorption cross-section of Tb^{160}. A

539.172.4 : 539.18

8384. THE ESTIMATION OF RESONANCE INTEGRALS. L.Dresner.
J. nuclear Energy, Vol. 2, No. 2, 118-27 (Dec., 1955).

Resonance parameters are now known for quite a large number of nuclei. Using this data, an attempt is made to predict the parameters for nuclei on which measurements have not been made, and, in particular the resonance integrals of these nuclei are estimated; these estimated resonance integrals are then compared with the experimentally determined values.

539.172.

8385. THE INTERACTION OF NEUTRON AND ALPHA-PARTICLE. E.van der Spuy.
Nuclear Physics, Vol. 1, No. 6, 381-414 (May, 1956).

The phenomenological neutron–alpha interaction is determined from the phase shifts in the scattering of neutrons on alpha particles, over the neutron energy range 0-10 MeV. From the notion of the alpha particle, acting as a single unpolarized unit in the scattering, comes the assumption that the interaction is mainly of the ordinary velocity-independent type, which may be easily subjected to phenomenological analysis. A new general analysis relates useful phase parameters to parameters defining interaction potential. For a consistent solution, on the basis of an ordinary potential with spin orbit coupling, which would give the main phase data, fo the S, P and D waves, one requires the interpretation of the S phases in terms of an attractive potential which has one bound state, rather than by a predominantly repulsive interaction. On this interpretation the "bound state" is not ob-

erved because the wave function for the corresponding $(1s)^5$ ate will vanish identically by the exclusion principle. Using e group resonance formalism the ordinary potential so ob- ined can be related to fundamental force parameters in a nsistent way, because the neutron–alpha interaction is in- ed seen to have only a secondary velocity-dependence for ese force parameters. The fundamental force-parameters e close to those required by low-energy nucleon–nucleon ta; they give the correct alpha binding energy, and have an change character which is non-saturating without a repulsive re. A.

539.172.4

386. NEUTRON RESONANCE PARAMETERS AND TRANS- ISSION MEASUREMENTS IN U^{235}. O.D.Simpson, .G.Fluharty and F.B.Simpson.
hys. Rev., Vol. 103, No. 4, 971-5 (Aug. 15, 1956).

Transmission measurements have been made for U^{235} with resolution of 0.05 to 0.07 μsec/metre using the Materials esting Reactor fast chopper, and resonances have been udied below 60 eV. Breit–Wigner parameters have been ob- ined for more than 40 resonances. Four new resonances ve been found at 12.8, 28.6, 29.9 and 34.7 eV. The 25.7 eV sonance previously reported has been split into two reso- ances, 25.6 and 25.9 eV. The ratio of Γ_n^0/D for resonances low 50 eV was found to be $1.0 \pm 0.2 \times 10^{-4}$. The level spacing 1.40 ± 0.15 eV is one of the smallest so far observed. Data the distributions of Γ_n^0 are presented. A.

539.172.4

387. INELASTIC SCATTERING OF NEUTRONS.
L.Morgan.
hys. Rev., Vol. 103, No. 4, 1031-4 (Aug. 15, 1956).

Inelastic scattering of fast neutrons in Al, Na, S, Fe, Cu, and Cd has been detected by observing the gamma radiation om the excited states. The cross-sections for gamma-ray roduction at energies well above threshold in Fe and Al have en measured. The gamma-ray energies observed corres- nd to known levels, transitions between levels, or de-excit- ion from neutron capture. A.

539.172.4

388. THE CLOUDY CRYSTAL BALL MODEL FOR 14 MeV EUTRON REACTIONS. M.Kawai, M.Nagasaki and H.Ui.
rogr. theor. Phys., Vol. 14, No. 3, 263-5 (Sept., 1955).

Various combinations of the parameters V and W in the mplex potential have been used to try and fit the experimen- l data of total elastic and inelastic cross-sections as a func- on of $A^{1/3}$. The continuum theory fails completely to predict e characteristic diffraction-like variation of the ratio of lastic to inelastic cross-sections as a function of $A^{1/3}$. It ppears that the optical model gives fair agreement however, e best parameters being V = 40 and W = 12 MeV. Better greement would probably result with the adoption of a shaped otential well. D.J.Prowse

539.172.4

389. ANGULAR DISTRIBUTION OF FAST NEUTRONS CATTERED BY MAGNESIUM. P.Okhuysen, Jr and .E.Millett.
ev. Mexicana Fis., Vol. 4, No. 1, 1-12 (Jan., 1955). In panish.

Reports a measurement of the differential cross-section lastic plus inelastic) of natural magnesium for fast neutrons stimated to have a mean energy of 2.77 ± 0.05 MeV) using e ring scatterer method. The neutrons were obtained from e D(d, n)He^3 reaction using a 100 000 volt modified Cockroft– alton accelerator. A.

539.172.4

390. SCATTERING OF FAST NEUTRONS BY LEAD AND LVER. T.Bonner, F.Alba and A.Fernández y Marcos azari.
ev. Mexicana Fis., Vol. 4, No. 1, 52-9 (Jan., 1955). In panish.

For abstract see Abstr. 4072 (1955).

539.172.4

8391. NUCLEAR CAPTURE OF NEUTRONS OF SEVERAL MeV. V.L.Gurevich.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 961-2 (1956). In Russian.

Capture by way of exciting charge-density vibrations in nuclei is formulated. G.E.Brown

539.172.4

8392. AN IMPROVED VARIATIONAL METHOD FOR THE SOLUTION OF THE ONE-GROUP DIFFUSION EQUATIONS. A.Hassitt.
J. nuclear Energy, Vol. 2, No. 2, 112-17 (Dec., 1955).

A variational method is applied to the solution of one-group, many-region diffusion equations. Finite series expansions of the density functions are taken, and in consequence the boundary conditions at an interface between two regions cannot be satisfied exactly. The variational principle takes explicit recognition of this fact, and in consequence should converge more quickly than the usual analytic methods. The method is used in such a way that it is not necessary to solve a transcendental equation: the secular determinant is solved by an iteration method. As an example, the critical size of a cylindrical reactor, with a large enclosed cavity, is calculated. The variational solution of the problem agrees with the solution found by relaxation methods. The solution found by first-order perturbation theory, on the other hand, differs from these by 9%. A.

539.172.4

8393. A NUMERICAL METHOD FOR SOLVING THE TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATION. R.M.Pearce.
J. nuclear Energy, Vol. 2, No. 4, 277-85 (June, 1956).

Conventional numerical methods for solving differential equations on a two-dimensional mesh are adapted to solving the one-group pile equation. The method yields the neutron density and the radial Laplacian in a standard manner which is not dependent on the number of control rods or other lattice irregularities. The procedures for calculation with a desk machine and with a large digital computer differ in certain respects, and are discussed. As an example, the distribution of neutron density is given for a reactor with seven asymmetrically inserted control rods. A.

539.172.4

8394. TRANSIENT EXPERIMENTS WITH THE SPERT-1 REACTOR. W.E.Nyer, S.G.Forbes, F.L.Bentzen, G.O.Bright, F.Schroeder and T.R.Wilson.
Nucleonics, Vol. 14, No. 6, 44-9 (June, 1956).

An account of tests on an enriched-fuel water-reflected and moderated reactor showing its behaviour during transient power excursions of up to 500 MW. Includes details of the construction of the reactor (core contained 3.86 kg U 235 in the Al-U-alloy fuel assemblies similar to BORAX assemblies) and the instrumentation used. The operating procedure and some results of transient tests with periods from 1.5–1000 msec are given. After the transient burst in SPERT-1 the power oscillations are more strongly damped than in BORAX-1. R.D.Smith

539.172.4

8395. TESTING OPERATING SAFETY OF A WATER-BOILER RESEARCH REACTOR. J.W.Flora and J.W.Shortall.
Nucleonics, Vol. 14, No. 6, 58-62 (June, 1956).

The Livermore Research Laboratory research reactor has a 12.5 in. diameter spherical core embedded in a 5 ft right cylindrical graphite reflector. The core contains 694 g U 235 in sulphate solution and operates at a power of 500 watts. Experiments made to determine its operating characteristics include: temperature coefficient of reactivity by observing change in reactor period as a function of core temperature, transient behaviour during power surges and a power-temper-

ature oscillation, build-up and decay of volatile activity, danger coefficients, effect of coolant loss and void effects in the reflector. R.D.Smith

539.172.4 : 621.039.4 : 621.317.7 : 621-52

8396. THE CONTROL AND INSTRUMENTATION OF A NUCLEAR REACTOR. A.B.Gillespie.
Proc. Instn Elect. Engrs, Paper 2058 M, publ. March, 1956 (Vol. 103 B, 564-76, 607-15).

Republication, with discussion, of the paper abstracted in Abstr. 3247 (1956).

539.172.4 : 621.039.4 : 621-52

8397. THE CONTROL OF NUCLEAR REACTORS. R.J.Cox and J.Walker.
Proc. Instn Elect. Engrs, Paper 2068 M, publ. March, 1956 (Vol. 103 B, 577-89, 607-15).

Republication, with discussion, of the paper abstracted in Abstr. 3248 (1956).

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

8398. ON THE CONSEQUENCES OF THE POSSIBLE EXISTENCE OF THE HYPERDEUTERON. M.Ferentz and S.Raboy.
Nuovo Cimento (Ser. 10), Vol. 4, No. 2, 487-90 (Aug., 1956).

It is suggested that the observation of a hyperdeuteron is an indirect method for detection of the neutral cascade particle which is predicted by the scheme of Gell-Mann and that of Salam and Polkinghorne. The consequences for these schemes are examined and some possible methods for preferential selection of one of the schemes are suggested. A.

539.18

8399. CHARGE CONJUGATION AND THE τ^0 MESON. G.A.Snow.
Phys. Rev., Vol. 103, No. 4, 1111-15 (Aug. 15, 1956).

The assumption of charge conjugation invariance, as used by Gell-Mann and Pais to discuss the decay of the θ^0 meson into two π-mesons, has been applied to the decay of the τ^0-meson into three π-mesons. Analogous to the θ^0-meson case, the τ^0-meson must be considered a "particle mixture" exhibiting two distinct lifetimes. There is no absolute selection rule against three-π-meson decay for either of these two τ^0 mesons, but their transition probabilities into three π-mesons are quite different. For example, if the τ-meson is a pseudoscalar particle, the ratio of these two transition probabilities is $\gg 100$. A brief discussion is given of other modes of decay of neutral heavy mesons and of some experimental consequences of this picture. A.

539.18

8400. ISOTOPIC SPIN CHANGES IN τ AND θ DECAY. R.H.Dalitz.
Proc. Phys. Soc. A, Vol. 69, Pt 7, 527-40 (July, 1956).

The decay of τ and θ particles is discussed on the hypothesis that the amplitude for an isotopic spin change of ΔT in τ and θ decay to pions should decrease with increasing ΔT, the transition $\Delta T = \frac{1}{2}$ being dominant. Assuming zero spin for τ and θ, the large difference between θ^0 and θ^+ lifetimes and the τ'/τ branching ratio (predicted as 0.32) both agree well with this hypothesis. A.

539.18

8401. RADIATIVE DECAY OF THE Λ^0-PARTICLE. P.V.Vavilov.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 985-7 (1956). In Russian.

The dependence on the Λ^0-particle spin of the process $\Lambda^0 \rightarrow p + \pi^- + \gamma$ is found to be small for low frequency photons but does influence the high energy end of the spectrum. G.E.Brown

539.1

8402. THE ANOMALOUS MAGNETIC MOMENT OF THE μ-MESON. S.Hirokawa, H.Komori and S.Ogawa.
Prog. theor. Phys., Vol. 14, No. 5, 494-5 (Nov., 1955).

The calculated frequencies of bursts produced by bremsstrahlung due to μ-mesons, with and without anomalous magnetic moments, are compared with the experimental results on bursts produced by cosmic-ray μ-mesons. It is concluded that the magnitude of the a.m.m. of μ-mesons does not exceed 80% of the normal Dirac moment. P.Rothwell

539.1

8403. PION–PROTON TOTAL CROSS SECTIONS FROM 0.45 TO 1.9 BeV. R.Cool, O.Piccioni and D.Clark.
Phys. Rev., Vol. 103, No. 4, 1082-97 (Aug. 15, 1956).

Measurements of the pion–proton total cross-section ov a range of kinetic energies from 0.45 to 1.9 BeV are describe Positive pions were distinguished from protons of the same momentum by a time-of-flight technique. A liquid hydrogen sorber was used for most of the measurements. Muons, the principal beam contamination, were approximately 10% of th pions. A pronounced maximum for $\sigma(\pi^-,p)$ near 0.9 BeV, whic had been noted in preliminary measurements, is confirmed. If this maximum is to be interpreted as a resonance in a sing state of angular momentum, the analysis shows that, after s tracting a term which can reasonably be attributed to non-resonant states, the total angular momentum could be as low as 5/2 without serious disagreement with experimental data. The possiblity of explaining this maximum with a resonant pion–pion interaction as conjectured by Dyson and Takeda is discussed. The measurements of $\sigma(\pi^+,p)$ also give evidence for the existence of a maximum of relatively smaller amplitu at 1.35 BeV. The differential cross-sections in the forward direction for elastic and charge-exchange scattering of pions by protons have been obtained by making use of the dispersio relations.

539.

8404. PHASE SHIFTS FOR PION–NUCLEON SCATTERIN AT 40 MeV. F.Mandl.
Phys. Rev., Vol. 103, No. 4, 1098-101 (Aug.15, 1956).

Approximate phase-shifts for the pion–nucleon system are obtained from the Chew–Low–Wick equations. At 40 M the set of phases: $\delta_1 = 6.26^0$, $\delta_3 = -4.2^0$, $\delta_{11} = -2.05^0$, $\delta_{13} = \delta_3 -0.82^0$, and $\delta_{33} = 4.1^0$, has the properties: (i) it satisfies the first iteration and the effective-range approximations of the Chew–Low–Wick equations, (ii) it satisfies the dispersion relations, (iii) it gives good over-all agreement with the experimental data within the experimental errors. Iteration of the effective-range approximation, for energies up to 200 MeV, gives good agreement for the δ_{13} and δ_{33} phases bu not for the δ_{11} phase-shifts.

539.

8405. DIFFRACTION SCATTERING OF HIGH ENERGY π-MESONS BY NUCLEONS. S.Z.Belen'kiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 983-5 (1956). In Russian.

A theoretical analysis for 1.4 BeV π's is carried out wi the semi-classical high-energy scattering formulae and wit the assumption of a grey nucleon with diffuse surface. G.E.Bro

539.

8406. ON STAR PRODUCTION BY μ-MESONS UNDERGROUND. E.P.George.
Proc. Phys. Soc. A, Vol. 69, Pt 5, 428-9 (May, 1956).

Recently the theoretical cross-section has been recalcu

ted and found to be lower than the experimental value by a actor of about 30. It is pointed out that certain conclusions uch as the anomalous μ-meson—nucleon interaction are not n fact valid. Most stars correspond to excitation energies bove threshold where the ordinary Coulomb dipole interaction etween the incident particle and the protons of the nucleus ould not be expected to hold. In particular the giant resonance n the photonuclear cross-section at 20 MeV is not explained y the use of this operator. An exact calculation using the hoto-mesic effects has not yet been performed.

D.J.A.Prowse

539.18

8407. A THEORY OF PION PHOTOPRODUCTION. M.Ross.
Phys. Rev., Vol. 103, No. 3, 760-76 (Aug. 1, 1956).

The photoproduction of pions from nucleons is calculated n the Tamm—Dancoff approximation to the relativistic pseudo-calar theory. The matrix elements are explicitly separated, n each partial wave, into production into plane waves and roduction associated with final-state scattering. These natrix elements are exhibited and compared in the energy egion up to 500 MeV. The agreement between theory and ex-periment is fairly good if one uses the same coupling con-tant used to calculate scattering in this approximation. The nhancement of the $P_{\frac{3}{2}}$, $T = \frac{3}{2}$ (M1) matrix element is about .5. A correction (applicable near threshold) for the noncon-ervation of isotopic spin due to the π^+-π^0 mass difference is valuated. A.

539.18

8408. SUPPRESSION OF PAIR EFFECTS IN DOUBLE π-MESON PHOTOPRODUCTION AT LOW ENERGIES. A.Petermann.
Phys. Rev., Vol. 103, No. 4, 1053-5 (Aug. 15, 1956).

The matrix element for the photoproduction of a (π^+, π^-) pair by γ-rays on protons is examined in the low-energy egion. Using the Deser—Thirring—Goldberger definition of he nucleon—meson interaction in a symmetric pseudoscalar heory with pseudoscalar coupling, it is shown that the leading erm in an expansion in k/M (k being the kinetic energy of the ight particles and M the mass of the nucleon), is exactly the air-term contribution in the perturbation result ($\sim eg^2$), but ccurring with the much smaller $g_g{}^2$ coupling constant. With he actual value of the pion mass, terms proportional, for nstance, to $(\mu/M)gp^2$ then become predominant. A.

539.18

8409. MESON PRODUCTION BY MESONS. S.Barshay.
Phys. Rev., Vol. 103, No. 4, 1102-7 (Aug. 15, 1956).

A calculation of meson production in a meson—nucleon ollision has been carried out for the processes $\pi^+ + p \rightarrow \pi^+ + \pi^+ + n$ and $\pi^+ + p \rightarrow \pi^+ + \pi^0 + p$, by means of the nethod of Low. Use has been made of an approximate form of he Chew—Low transition matrix for scattering off the energy hell. This matrix exhibits explicitly the resonance behaviour f the isotopic spin 3/2, angular momentum 3/2 scattering tate. At 350 MeV incident-meson kinetic energy, the cross-ection for π^+ production is 0.86 mb and that for π^0 production s 5.5 mb. The angular distribution of each final state meson s of the form $A + \cos^2\theta$. For π^+ production, at 250 MeV inci-ient-meson kinetic energy, A = 0.64. The two final-state pions seem to share the available kinetic energy. The probability or a spin flip of the nucleon in the process is about 1.5 times he probability for no spin flip. A.

539.18 : 539.172.3

PRODUCTION OF A NUCLEAR STAR AND A π-MESON BY A γ-RAY. See Abstr. 7688

539.181 : 539.132

8410. ON WAVE NATURE OF MATTER. II. B.Mishra.
Indian J. Phys., Vol. 30, No. 6, 273-5 (June, 1956).

For previous part see Abstr. 8998 (1951). Investigation on the diffraction of a molecular beam by apertures of differ-ent shapes and sizes has been carried out and it is observed that straight slits produce a pair of fringe-like deposits with a minimum at the centre, the width of the fringe being smaller in the case of the wider slit. In the case of circular apertures, circular deposits are formed at the centre, the radius of the central disk being smaller for the larger aperture. A.

539.185

8411. ON THE DETERMINATION OF DIFFUSION AND SLOWING-DOWN CONSTANTS OF ORDINARY WATER AND BERYLLIUM OXIDE, USING A PULSED NEUTRON SOURCE. R.Ramanna, G.S.Mani, P.K.Iyengar, S.B.D.Iyengar and B.V.Joshi.
J. nuclear Energy, Vol. 2, No. 3, 145-52 (March, 1956).

A method of obtaining the diffusion constants and the age to thermal energy of water and beryllium oxide, using a pulsed neutron source, is described. Such a method has been used by L.J.Haworth et al. (1942) in the measurement of the mean life of thermal neutrons in water and by von Darel (1953) in the measurement of the diffusion length in water and heavy water. The main advantages of this method are that comparatively small quantities of the moderator material are required, and it is possible to determine the absorption mean free path, transport mean free path, and the age to thermal energy directly. In the case of water moderator of infinite dimensions, the interpretation of the decay constants depends very much on the choice of the theory. A.

539.185

8412. EFFECT OF MODERATOR TEMPERATURE UPON NEUTRON FLUX IN INFINITE, CAPTURING MEDIUM. R.R.Coveyou, R.R.Bate and R.K.Osborn.
J. nuclear Energy, Vol. 2, No. 3, 153-67 (March, 1956).

The integral equation governing the dependence upon speed of the neutron flux for moderation in an infinite, capturing medium has been solved by Monte Carlo methods. Effects on the flux due to the thermal motions of the scattering and absorbing atoms are taken into account within the context of the assumption that the thermal speed distributions are Maxwell—Boltzmann in character. Results for several different scattering masses and several different (1/v)-absorption cross-sections are presented in detail. A.

539.185

8413. NEUTRON REFLECTING MIRRORS FOR DETERMINING COHERENT SCATTERING CROSS SECTIONS. C.J.Heindl, I.W.Ruderman, J.M.Ostrowski, J.R.Ligenza and D.M.Gardner.
Rev. sci. Instrum., Vol. 27, No. 8, 620-2 (Aug., 1956).

Mirrors suitable for determining coherent cross-sections by the neutron reflection technique are prepared by evaporating a sample on a flat electrochemically polished vanadium plate. Samples of separated isotopes as small as 20 mg may be used. A.

539.185

8414. DETERMINATION OF THE ABSOLUTE OUTPUT OF NEUTRON SOURCES. M.A.Bak, K.A.Petrzhak and Yu.F.Romanov.
Uspekhi fiz. Nauk, Vol. 58, No. 4, 667-84 (1956). In Russian.

The methods of measurement available are reviewed very briefly starting with Dunning and with Fermi (1934) and finishing with Gailloud, Haenny and Weill (Abstr. 3380/1955). A useful table summarizing the state of the topic and its development is given. 47 refs. C.R.S.Manders

539.185.08

8415. A TIME OF FLIGHT NEUTRON VELOCITY SELECTOR USING SCINTILLATION COUNTER. A.P.Patro.
Indian J. Phys., Vol. 30, No. 3, 99-105 (March, 1956).

A method of selecting neutrons of different energies in the range 1 keV to 30 keV is described. The method utilizes scintillation counters for the detection of neutrons, and neutron energies are measured from the time elapsing in its travel

from one scintillating phosphor to a second phosphor. It is shown that the method is capable of greater resolution than the usual time-of-flight methods and various improvements are suggested. Measurements of transmission curves ($\sim \sigma_t$) have been made in the above energy range for vanadium, manganese and bismuth. The evidence of resonances for these elements is found and discussed. A.

539.185.08

8416. SOME EFFECTS OF THE SELF-ABSORPTION OF NEUTRONS IN NEUTRON-DETECTING FOILS.
M.W.Thompson.
J. nuclear Energy, Vol. 2, No. 4, 286-90 (June, 1956).

The distortion of neutron flux by detecting foils is discussed and a method described by which it has been measured. The results, which are compared with theory, show how the mean distorted flux changes with foil-thickness for indium foils in different graphite-pile spectra. From these results the effect of a change in irradiation spectrum on the intercalibration of foils is calculated. The interaction of two indium foils in the same graphite system has been studied experimentally. A.

539.185.08

8417. ON THE THEORY OF THE DISTURBANCE [OF A THERMAL NEUTRON FIELD] DUE TO DISK-SHAPED NEUTRON PROBES, WHOSE RADIUS IS SMALL COMPARED WITH THE SCATTERING PATH-LENGTH OF THE MEDIUM.
H.Meister.
Z. Naturforsch., Vol. 11a, No. 5, 347-56 (May, 1956). In German.

The analogous case for spherical probes has already been handled by Bothe (Z. Phys., Vol. 120, 437, 1943). The supposition by Tittle (Abstr. 8231/1951) that Bothe's formula for spherical probes gives good agreement for disk-shaped probes, if the appropriate values for the probe radius and absorption probability are inserted, leads to values which are about 25% lower than those obtained from the calculations in this paper. The results of this paper agree well with those of author's experimental work (Abstr. 1595/1956) using indium foils in graphite. H.C.Cole

539.185.08

8418. THE DISTURBANCE OF THE NEUTRON DENSITY IN THE NEIGHBOURHOOD OF AN ABSORBING PROBE.
H.Meister.
Z. Naturforsch. Vol. 11a, No. 5, 356-9 (May, 1956). In German.

The alteration of the density distribution of thermal neutrons in graphite by the presence of a disk-shaped probe has been examined experimentally. For large distances from the probe surface the measured results agree with elementary diffusion theory; for points near to the surface of the probe the experimental values can be explained through the formula derived in a previous paper (see preceding abstract). H.C.Cole

STRUCTURE OF SOLIDS 539.2

539.21

8419. ON THE MECHANISM OF IRRADIATION ANNEALING.
R.S.Barnes and M.J.Makin.
J. nuclear Energy, Vol. 2, No. 4, 291-8 (June, 1956).

The nonlinearity of the resistivity/integrated-flux curve obtained by Cooper, Koehler, and Marx (1955) during the deuteron bombardment of copper wires at 10^0K is considered to be due to a bombardment-induced annealing process quite distinct from the thermal annealing which is observed at higher temperatures. Three possible causes of this irradiation annealing are discussed. The local temperature rise around the track of the incident deuteron (the "thermal spike") is of insufficient extent and duration to permit the observed amount of annealing. The local melting which might occur in displacement spikes also seems insufficient. If, however, an individual knock-on at the end of its track travels, not by itself moving from one interstitial position to the next, but by taking the lattice position of a neighbouring atom, forcing that atom into the neighbouring interstitial position, then the interstitial atom could effectively travel many atomic distances at low speeds, because the energy lost during such movement should be low. The result of such an interstitial atom passing within a critical distance of a stationary vacancy would be mutual annihilation, and a decrease in the resistivity. If this critical distance is three atomic spacings then it is sufficient that the interstitial atom travels about eighteen atomic spacings in the manner described to give the amount of annealing observed in the experiments. A.

539.21

8420. VACANCIES AND DISPLACEMENTS IN A SOLID RESULTING FROM HEAVY CORPUSCULAR RADIATION.
W.S.Snyder and J.Neufeld.
Phys. Rev., Vol. 103, No. 4, 862-4 (Aug. 15, 1956).

The number of displacements D(E) and the number of vacancies V(E) produced in a monatomic solid as a result of collisions due to an incident ion of initial energy E, are obtained as solutions of the equation

$$f(E) = \int_0^E dy K(E,y)\{p(y)[f(y-\alpha) + 1 - \theta q(E-y)] + [1 - p(E-y)q(y)]f(y)\},$$

where $f(E) = D(E)$ or $V(E)$, $p(y)$ denotes the probability that a struck atom is displaced when it has received energy y, $q(E-y)$ is the probability that the striking atom replaces it if displacement has occurred, $K(E,y)$ is the scattering kernel, and α is the minimum amount of energy that is assumed to be necessary to displace an atom (it is assumed that the struck atom loses energy α in breaking away from its lattice site). In the equation, $f(E) = 0$ for $E < \alpha$, with $\theta = 0$ for displacement and $\theta = 1$ for vacancies. This equation is solved for some representative cases of $p(y)$ and $q(y)$. The functions $p(y)$ and $q(y)$ can be chosen to fit experimental estimates of either D(E) or V(E) singly but indicate a fundamental discrepancy of the joint estimates. The discrepancy, if not due to inaccuracy in the interpretation of experimental results, suggests that a mathematical model based on individual collisions is inadequate A.

539.213

8421. A STRUCTURAL EXPLANATION OF THE BORON OXIDE ANOMALY. K.Grjotheim and J.Krogh-Moe.
K. Norske Vidensk. Selsk. Forhandl., Vol. 27, No. 18, 94-100 (1954).

It is suggested that the anomaly is due to a change of the configuration around boron from a larger coordination number in boron oxide glass to a smaller coordination number in the alkali borate glasses. The theory is found to be consistent with various physical properties of these systems. The proposed explanation is also found not to be contradicted by the X-ray investigations on borate glasses. A.

539.213.2 ; 539.89

8422. EFFECT OF PRESSURE ON GLASS STRUCTURE.
O.L.Anderson.
J. appl. Phys., Vol. 27, No. 8, 943-9 (Aug., 1956).

The anelastic response of a glass structure to pressure is examined in terms of the random-network hypothesis. The analysis is based upon the premise that an asymmetrical distribution of bond lengths characterizes the randomness of the network. It is found that the effect of pressure is to change the amount of skewness and therefore the average bond length which determines the density. Two kinds of persisting density changes are found. One is reversible and is called densifica-

ion, and the other is irreversible and is called compaction. Experimental results for Corning 7052 glass show that both densification and compaction exist for combinations of the p, T, τ conditions, 3800 to 6600 atm, 100-300° C, 15 min—1 week. These experiments also show that the kinetics of the densification process agree qualitatively with that predicted by the theory. A.

539.215.08

8423. THE ACCURACY OF PARTICLE SIZE DETERMINATION BY CUMULATIVE SEDIMENTATION METHODS. J.K.Donoghue.
Brit. J. appl. Phys., Vol. 7, No. 9, 333-6 (Sept., 1956).

Cumulative methods of particle size and analysis are sometimes alleged to be inaccurate because it is necessary to differentiate the sedimentation curve in order to evaluate the size distribution. By considering a hypothetical distribution it has been shown that, provided sufficient points are obtained to enable the sedimentation curve to be plotted accurately, this differentiation does not give rise to errors. Comparative tests with the microscope and sedimentation balance on two samples composed of spherical particles confirm this conclusion. A.

539.217

8424. THE INTERDIFFUSION OF URANIUM AND ALUMINIUM. A.D.Le Claire and I.J.Bear.
J. nuclear Energy, Vol.2, No.4, 229-42 (June, 1956).

Results are given of measurements of the width, as a function of temperature and pressure, of the diffusion zone formed by the interdiffusion of uranium and aluminium and of the relative penetration of uranium into aluminium and of aluminium into uranium. The experiments are unusal among diffusion measurements in showing an appreciable accelerating effect of pressure on the rate of interdiffusion. This is most marked for temperatures, below ~540°C. The penetration of the uranium into the aluminium is about $2\frac{1}{4}$ times faster than that of the aluminium into the uranium. The results of a microscopical and X-ray examination of the diffusion zone are presented, and a discussion is given of the possible origins of the pressure effect. A.

539.217

8425. INFLUENCE OF AN ELASTIC STRAIN ON THE SELF-DIFFUSION OF COPPER AT LOW TEMPERATURES. M.J.Druyvesteyn and C.W.Berghout.
Phys. Rev., Vol. 102, No. 6, 1686 (June 15, 1956).

The mobility of vacancies "injected" by cold working was studied by plotting the recovery of resistivity of a wire after stretching, as a function of time. It was found that loading the wire speeds up the recovery, the diffusion coefficient becoming anisotropic. T.P.Brody

539.217 : 541.124

8426. ON THE DIFFUSION OF COPPER AND OXYGEN ATOMS IN THE FORMATION OF THE COPPER-OXIDE LAYER. A.I.Andrievskiĭ and M.T.Mishchenko.
Zh. tekh. Fiz., Vol. 26, No. 2, 430-5 (1956). In Russian.

Microscopic examinations at various temperatures confirm that during oxidization of copper opposite diffusion of the metal and oxygen atoms takes place through the hammer-scales. The relative diffusion intensity varies with the temperature of oxydation. It is shown that up to temperatures of 1020° C the oxygen diffusion rate is greater; at higher temperatures however the opposite stream of copper atoms becomes increasingly more intense. J.Jacobs

539.217

8427. THE DIFFUSION OF IMPURITIES IN GERMANIUM. B.I.Boltaks.
Zh. tekh. Fiz., Vol. 26, No. 2, 457-74 (1956). In Russian.

Review of the literature, both Russian and western. Discusses methods of measuring the diffusion constant; tabulates values at 800° C and gives a plot of the variations with temperature, for the impurities Li, Cu, Au, Zn, B, Ga, In, P, As, Sb and Ni. There is also a section on the solubility of these elements in germanium. J.M.Radcliffe

539.219

8428. SOLUTE DIFFUSION IN METALS. L.C.R.Alfred and N.H.March.
Phys. Rev., Vol. 103, No. 4, 877-8 (Aug. 15, 1956).

Use of more accurate fields around the solute atoms is shown to decrease very appreciably the discrepancy found by Blatt between the activation energies for solute diffusion in silver obtained from the theory of Lazarus and the experimental values. A.

539.234

8429. VACUUM DEPOSITION OF THIN FILMS. L.Holland.
London: Chapman and Hall (1956) xix + 541 pp.

This is the most up-to-date comprehensive treatise on the technology of thin film deposition by vacuum evaporation or by cathodic sputtering and on the physical properties of such films. Chapters 1-6 deal with the main design features of vacuum evaporation plant, together with particular requirements for the coating of volatile materials; the types of volatiles present in plastic materials and the mechanism by which they are desorbed at low pressure; methods of cleaning the substrate; the durability and adhesion of vacuum deposited films; the construction and arrangement of filament and foil vapour sources, crucibles and heating elements; the emission characteristics of vapour sources and the distribution of film thickness over the substrate surface; and evaporation techniques for several particular metals and alloys. Chapter 7 discusses the growth, structure and physical properties of vacuum deposited films. Chapters 8, 11-13 and 15-16 are devoted to thin films for electrical purposes, evaporated Al films, coatings on plastics and lacquered components, shadow casting and surface replication and the preparation and properties of metal oxide films. Chapters 9-10 describe the various types of optical interference films, their uses and apparatus for their controlled deposition, and Chapter 14 is a critical account of cathodic sputtering. Throughout the volume the emphasis is on practical details and technical procedures and the author quotes from his own personal experience and that of others, giving much original information. The deposition characteristics and refractive indices of an extensive range of organic compounds are listed in an appendix and much useful data are given in the numerous tables and graphs in the text. This book is an indispensable reference book and guide to the research worker in both industrial and other research laboratories. 25 plates and 557 refs. S.Weintroub

539.234

8430. PREPARATION OF SCATTERING FOILS OF URANIUM BY EVAPORATION OF THE METAL IN HIGH VACUUM. K.K.Damodaran.
Brit. J. appl. Phys., Vol. 7, No. 9, 322-3 (Sept., 1956).

Scattering foils of uranium were prepared by evaporating uranium in high vacuum and depositing it on thin backing foils of aluminium. The average thickness of each foil was determined by direct weighing. The variation in thickness of each of the foils was measured by counting the α- and β-radiations emitted by uranium from the various parts of the foil, using a Geiger-Müller counter. A.

539.26 : 539.213 : 666

8431. A COMMENT ON THE X-RAY DETERMINATION OF GLASS STRUCTURES. O.Borgen, K.Grjotheim and J.Krogh-Moe.
K. Norske Vidensk. Selsk. Forhandl., Vol. 27, No. 17, 86-93 (1954).

The radial distribution curves obtained by X-ray diffraction are often used to determine coordination numbers. Some of the several sources of errors affecting the determination

of these experimental coordination numbers are discussed. It is concluded that coordination numbers determined by the present X-ray technique should be taken with some reservation. A.

539.264

8432. DETERMINATION OF THE SHAPE OF CORPUSCULAR AND FIBROUS MACROMOLECULES BY THE X-RAY SMALL-ANGLE METHOD. O.Kratky.
Z. Elektrochem., Vol. 60, No. 3, 245-61 (1956). In German.

Methods of determination of shape and size are reviewed, and some results obtained with silk derivatives are given. A.R.Stokes

539.27

8433. COAL SURFACE ANALYSIS BY MEANS OF AN ELECTRON MICROSCOPE. A.Feltynowski and I.Glass.
Acta phys. Polon., Vol. 15, No. 1, 75-6 (1956).

A two-stage method for replicating coal for electron microscope observation is described. The polished coal surface is etched with chromic acid and layer of "saponlack" applied. After drying, this is stripped off and pre-shadowed with chromium. An aluminium layer is then evaporated on, and the saponlack dissolved in amyl acetate. The aluminium layer with chromium pre-shadowing is mounted for observation in the electron microscope. The process takes 48 hours, including 36 hours for the saponlack to harden, and 12 hours for solution. M.E.Haine

539.27 : 538.221

A STUDY OF BITTER FIGURES USING THE ELECTRON MICROSCOPE. See Abstr. 7531

ELASTICITY. STRENGTH. RHEOLOGY 539.3/.8

539.31

8434. THE INTERNAL FRICTION OF COLD WORKED COPPER AT LOW TEMPERATURES. D.H.Niblett and J.Wilks.
Phil. Mag. (Ser. 8), Vol. 1, No. 5, 415-18 (May, 1956).

A preliminary report of part of a more detailed survey of the variation of internal friction with temperature at low temperatures of cold worked metals as reported by Bordon (Abstr. 1333/1950, 9020/1954). Specimens of 99.999% polycrystalline copper were annealed in argon for 1 hour at 600°C, then plastically deformed in tension. The internal friction was measured by resonating the bars electrostatically in a transverse mode (~ 1100 c/s) and observing the decay of oscillations. The friction depends on the prior cold work in a complicated manner. Two peaks were revealed in the plot of internal friction v. temperature and they are considered to be of the type associated with a relaxation phenomena, such as the motion of a segment of a dislocation line. A detailed mechanism due to Seeger (Theorie der Gitterfehlstellen, Handbuch der Physik, Vol. 7/1, 1955, p.606 seq.) is preferred to that of Mason. W.Bardsley

539.31 : 534.2

8435. TRANSITION TO GEOMETRICAL APPROXIMATION IN ELASTICITY THEORY. M.L.Levin and S.M.Rytov.
Akust. Zh., Vol. 2, No. 2, 173-6 (April-June, 1956). In Russian.

It is shown that the law of change of polarization of displacement waves along rays also follows from the ideal equations of elasticity in geometrical approximation just as the equation of state and laws of conservation of energy flow in compression and displacement waves. This polarization law is shown to be the same as for electromagnetic waves. C.R.S.Manders

539.374

8436. DENSITY CHANGES DURING THE ANNEALING OF DEFORMED NICKEL. L.M.Clarebrough, M.E.Hargreaves and G.W.West.
Phil. Mag. (Ser. 8), Vol. 1, No. 6, 528-36 (June, 1956).

A differential method has been used to measure the changes in density which accompany the annealing of plastically deformed nickel. The results of these measurements are correlated with earlier measurements of stored energy, electrical resistivity and hardness for the same material. There are two sudden increments in density; the first is attributed to the disappearance of vacancies and the second to recrystallization. These are superimposed on a gradual increase in density attributed to recovery. There is a considerable discrepancy between the densities of dislocations calculated from the stored energy measurements and from the density measurements. A.

539.434 : 536.48

8437. CREEP IN METAL CRYSTALS AT VERY LOW TEMPERATURES. N.F.Mott.
Phil. Mag. (Ser. 8), Vol. 1, No. 6, 568-72 (June, 1956).

A theory is given of creep in metallic single crystals at very low temperatures, which is based on the hypothesis that dislocations can pass through barriers, such as those provided by dislocations crossing the slip plane, owing to the quantum-mechanical tunnel effect. A detailed theory would depend on a knowledge of the atomic arrangements at the centre of a dislocation, which in this case does not exist, but a rough calculation shows that creep should be independent of temperature below about 10°K in cadmium. A.

539.531

8438. INDENTATION HARDNESS OF DIAMOND. P.Grodzinski.
Nature (London), Vol. 177, 1228 (June 30, 1956).

A plot is made for average pressures and maximum pressures in various reported experiments on indentation hardness testing of diamond, using various diamond indenters. Average pressures with triangular and elongated pyramids are high, but with spheres and double cones relatively low. The observed differences are accounted for. In the one case there is a plastic flow at shear stress, in the other elastic deformation precedes fracture. S.Tolansky

539.62

8439. THE TENSION IN STRINGS WRAPPED SLANTWISE ROUND CYLINDERS WHEN FRICTION IS PROPORTIONAL TO A POWER OF THE NORMAL REACTION. C.Mack.
Brit. J. appl. Phys., Vol. 7, No. 8, 294-6 (Aug., 1956).

It is now well established that for many, if not most, pairs of materials in contact friction is proportional to a power, smaller than unity, of the normal reaction. The relations between tension, normal reaction, curvature and certain angles are found for a string wrapped slantwise round a cylinder of general cross-section for friction obeying this law: (i) when friction acts tangentially to the string path, and (ii) when it acts parallel to the cylinder axis. A.

539.621

8440. APPARATUS FOR FRICTION STUDIES AT HIGH VACUUM. V.R.Johnson, G.W.Vaughn and M.T.Lavik.
Rev. sci. Instrum., Vol. 27, No. 8, 611-13 (Aug., 1956).

Sliding motion inside the vacuum chamber is accomplished by magnetic coupling through the chamber wall. The lag angle between the magnets, observed by means of stroboscopic illumination, measures the friction. Calibration of the magnetic coupling is obtained from the period of oscillation of the driven magnet with respect to the driving magnet. A.

539.89 : 536.413.2 : 536.631

8441. CERTAIN THERMODYNAMIC PROPERTIES OF A SOLID UNDER HIGH PRESSURE. K.P.Rodionov.
Zh. tekh. Fiz., Vol. 26, No. 2, 375-8 (1956). In Russian.

The author examines the effect of high pressure upon the spectrum of elastic oscillations of atoms and ions for a linear single-atom chain solid body. From this the Debye temperature is worked out and shown to be an exponential function of pressure. The case of a cubic crystal lattice is also considered and the coefficient of change of Debye temperature with pressure is calculated. This enables the variation of the coefficient of linear thermal expansion of a solid under high pressure to be determined. It is shown that the coefficient should decrease with increase of temperature, and the experiment confirms this to be the case for all known metals. C.R.S.Manders

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.115

8442. ENTROPIES OF HYDRATION OF GASEOUS OXY-ANIONS. A.P.Altshuller.
J. chem. Phys., Vol. 24, No. 4, 642-3 (April, 1956).

The entropies of 17 oxy-anions have been calculated in the (hypothetical) gas state. The gas entropies for these ions have been combined with their molal entropies in aqueous solution, $\bar{S}^0$, where available, to calculate the entropies of hydration of 14 of these ions. The entropies of hydration of these ions having the formula, XO_n^{-m}, can be represented by the empirical equation $\Delta S_{hyd} = 5 + (29 - 4.5n)Z^2$. A.

541.118

8443. THE STABILITY OF BERYLLIA AND MAGNESIA IN DIFFERENT ATMOSPHERES AT HIGH TEMPERATURES. D.T.Livey and P.Murray.
J. nuclear Energy, Vol. 2, No. 3, 202-12 (March, 1956).

The behaviour of beryllia and magnesia under various conditions of atmosphere at high temperatures is discussed. Beryllia volatilizes readily in the presence of water vapour whereas magnesia does not. This is in conformity with the general high stability of gaseous beryllium compounds compared with those of magnesium. In vacuo or in reducing atmospheres, magnesia volatilizes readily and this obviates its use as a high-temperature material under these conditions. Beryllia however is stable under these conditions. Calculations are made using the Knudsen relationship on the rates of loss in weight to be expected under equilibrium conditions for the various atmospheres mentioned above, and these are shown to account for the losses observed experimentally. A.

541.126 : 536.46

8444. GASEOUS DETONATIONS. VIII. TWO-STAGE DETONATIONS IN ACETYLENE—OXYGEN MIXTURES. G.B.Kistiakowsky and P.C.Mangelsdorf, Jr.
J. chem. Phys., Vol. 25, No. 3, 516-19 (Sept., 1956).

For Pt VII, see Abstr. 1165 (1956). Detonation waves in acetylene—oxygen mixtures containing slightly more than 70% acetylene were studied using a slit and a moving film camera combination. It was observed that an initially diffuse luminous region part way down the rarefaction wave gradually sharpens into a strongly luminous shock front which then overtakes the primary wave front. Thereafter, a single wave moves forward with a velocity intermediate between those of the two initial waves. The region behind the rear shock front shows strong luminous particle tracks, whereas the region between is free of them. These observations are interpreted as evidence that acetylene left over after the oxidation reaction decomposes into carbon and hydrogen only after an induction period which is a sensitive function of the temperature and concentration of acetylene. The hydrodynamic aspects of the observations are discussed and are found to be consistent with the above explanation. A.

541.126 : 536.46

THE THEORY OF FLAME PHENOMENA WITH A CHAIN REACTION. See Abstr. 7346

541.127

8445. METHYLIC AFFINITY OF QUINONES. G.Giacometti.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1488-90 (June, 1956). In Italian.

The methylic affinity as defined by Szwarc (J. Amer. Chem. Soc. Vol. 76, No. 13, 3439 and No. 23, 5981/1954; Vol. 77, No. 7, 1949, and No. 17, 4468/1955) is discussed for the case of quinones. Without any hypothesis about the region of attack it is possible to correlate the order of reactivity with suitable structural electronic indices of the molecules so that the position of the attack follows as a logical consequence, and it is found to be rather at the quinonic oxygen than at the doubly bound carbon atoms. As examples p-benzoquinone, 1-4 naphtho-quinone and anthraquinone are dealt with. R.Neumann

ELECTROCHEMISTRY 541.13

541.132 : 537.214

8446. THE HYDROGEN ION COULOMETER. H.W.Hoyer.
J. phys. Chem., Vol. 60, No. 3, 372-3 (March, 1956).

A new type of coulometer is described based upon the removal of hydrogen ion and chloride ion from a standard solution of hydrochloric acid in potassium chloride solution. As little as one and as many as 360 coulombs have been successfully determined. The method is particularly suited for systems in which a predetermined quantity of electricity is to be passed through a solution. The end-point can then be selected with an ordinary pH meter at a pH equal to that of the distilled water used in preparing the standard solution. A.

541.133

8447. THE THEORY OF ELECTRICAL CONDUCTION ANISOTROPY OF POLYELECTROLYTES IN SOLUTION. G.Schwarz.
Z. Phys., Vol. 145, No. 5, 563-84 (1956). In German.

An electric field produces a strong polarization in a polyion (of rod-like shape) with its attendant cloud of gegenions, the polyion thus tending to orient itself with its length parallel to the field. Orientation (kinematic) is also considered to result when, for example, a stream-line flow gradient is set up in the solution. In both cases a change in electrical conductance of the solution up to 30% is found. The mathematical theory is developed. W.Good

541.133 : 532.74

CONDUCTIVITY OF STRONG ELECTROLYTES AT MODERATE CONCENTRATIONS. See Abstr. 7200

541.135

8448. DEPOSITION OF URANIUM DIOXIDE ON ALUMINIUM BY ELECTROLYSIS. L.Koch.
J. nuclear Energy, Vol. 2, No. 2, 110-11 (Dec., 1955). In French.

A method is described for the preparation of UO_2 layers strongly adherent to large areas of aluminium sheet. The thickness of the deposits may reach 3 mg/cm^2. A.

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.14 : 537.312.5

8449. PHOTOCHEMICAL PROPERTIES OF CADMIUM SULPHIDE. E.A.Niekisch, U.Pflaum and R.Rompe.
Z. phys. Chem. (Leipzig), Vol. 205, No. 3, 146-59 (Jan., 1956). In German.

Light is found to produce blackening in single crystals of CdS surrounded by water. No blackening is shown by crystals immersed in nitrobenzene, acetone, carbon tetrachloride or surrounded by moist air. The blackening deepens by as much as 25% within 24 hours when the crystals are kept in water in the dark (the reverse behaviour is shown by the blackening of exposed ZnS). The effect of the electrolytes, $AgNO_3$, $CuSO_4$, $CdCl_2$ is to hasten the development of blackening. The influence of the intensity and wavelength of light on the production of blackening and on the photoconduction of blackened crystals is investigated. It is suggested that reactions of conduction electrons and holes with the ions in the water occluded in the crystal surface probably play an essential role in the photolysis. W.Good

541.144

8450. RATE OF ASSOCIATION OF n-PROPYL RADICALS. S.G.Whiteway and C.R.Masson.
J. chem. Phys., Vol. 25, No. 2, 233-7 (Aug., 1956).

The rate of association of n-propyl radicals has been measured by studying the photolysis of di-n-propyl ketone in intermittent light. A value of $k_2' = 1 \times 18^{-8}$ cm^3 molecule^{-1} sec^{-1} at 100° has been obtained. Possible sources of error have been discussed and it is concluded that the above value may be too high by a factor of the order of 20, thus indicating that reaction probably occurs at every collision. A value of $k_3/k_2 = 0.125 \pm 0.01$ has been found, where k_3 and k_2 are the rate constants for disproportionation and combination, respectively. A.

541.15

8451. EFFECTS OF X-IRRADIATION UPON SOME ORGANIC SUBSTANCES IN THE SOLID STATE: SIMPLE ALCOHOLS, AMINES, AMIDES AND MERCAPTANS. C.F.Luck and W.Gordy.
J. Amer. Chem. Soc., Vol. 78, No. 14, 3240-3 (July 20, 1956).

Microwave magnetic resonance has been employed to study the effects of ionizing X-rays on these substances in the solid state. The proton hyperfine structure of the electron spin resonance allows fairly definite identification of the radicals produced in certain of these. For example, methyl alcohol, acetamide, sodium methoxide appear to form the radical $(CH_2)^+$, which, however, could be attached to some other molecule or group provided that the group has no nuclei which could interact with the electron spin. Ethyl alcohol and propionamide appear to form the radical $(C_2H_4)^+$. No such radicals are formed by the sulphur compounds, and it is believed that the odd electron (electron vacancy) in these remains on the S atom or atoms. A.

541.15

8452. MICROWAVE INVESTIGATIONS OF RADIATION EFFECTS IN SOLIDS: METHYL AND ETHYL COMPOUNDS OF Sn, Zn AND Hg . W.Gordy and C.G.McCormick.
J. Amer. Chem. Soc., Vol. 78, No. 14, 3243-6 (July 20, 1956).

Microwave magnetic resonance spectra of the unpaired electrons have been used to investigate the effects of ionizing X-irradiation on frozen (at 77°K) methyl and ethyl compounds of Zn, Hg and Sn. The $(C_2H_4)^+$ radical is believed to be produced from $Hg(CH_3)_2$, the C_2H_5 radical from $Hg(C_2H_5)_2$ and the CH_3 radical from $Zn(CH_3)_2$. The radical $(ZnCH_2)^+$ is apparently also produced in $Zn(CH_3)_2$ probably by a secondary reaction. The type of radical is indicated by the proton hyperfine structure of its electron spin resonance. From the spacing of the hyperfine multiplets information about the electronic structure of the radical is obtained. The radicals produced in $Sn(CH_3)_4$ could not be definitely identified, but one type appears to be $(C_2H_4)^+$. A.

541.15

8453. POLYMERIZATION OF VINYL CHLORIDE INDUCED BY GAMMA-RAYS. A.Chapiro.
J. Chim. phys., Vol. 53, No. 6, 512-14 (June, 1956). In French.

The monomer was pre-polymerized by gamma radiation to about 10% before the final distillation for the experiments. The dose-rate dependence of the reaction velocity and ensuing viscosity was studied and polymerization after the end of the exposure observed. The kinetics of this polymerization in the liquid phase show the same characteristics as in the case of classical initiators. This indicates no localization of free radicals along particle tracks. M.Ebert

DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.183 : 541.128 : 537.311.33

8454. THE IONIC ADSORPTION OF GASES ON SEMICONDUCTORS AND THEIR CATALYTIC ACTIVITIES. I. THE THEORY OF ADSORPTION. T.Takaishi.
Z. Naturforsch., Vol. 11a, No. 4, 286-97 (April, 1956).

A general theory is developed, with particular consideration for the combination of the types of semiconductors and the signs of the electric charge on the adsorbed molecules. The results obtained agree qualitatively with experiments, but contradict predictions made by Dowden who in his theory does not take the space-charge layer near the surface into account. In the last section, physical models for adsorption sites are speculatively considered A discussion of the catalytic activities of semiconductors based on the present theory of adsorption is given. The applications to special reaction systems is given in Pt II. A.

541.183 : 541.128 : 537.311.33

8455. THE IONIC ADSORPTION OF GASES ON SEMICONDUCTORS AND THEIR CATALYTIC ACTIVITIES. II. THE LAW OF THE VIRTUAL ATMOSPHERE AND ITS APPLICATIONS. T.Takaishi.
Z. Naturforsch., Vol. 11a, No. 4, 297-306 (April, 1956).

The theory of the catalytic activity of semiconductors is extended on the basis of the conclusions of Pt I as to the ionic adsorption of gases. By introducing the concept of a "virtual atmosphere", a guiding principle for the selection of catalysts is obtained. The law of the virtual atmosphere here derived is applied to the oxidation of carbon monoxide on a semiconductor, and provides the reasons the Rideal mechanism in this reaction is observed not on n-type but on p-type semiconductor catalysts. Moreover, the relation between the catalytic activity and the history of a sample is reasonably interpreted in terms of the virtual atmosphere. Other reactions such as the decomposition of nitrous oxide and the synthesis of methanol are discussed qualitatively. A.

CHEMICAL STRUCTURE 541.2/.6

541.57 : 541.66

8456. LIGAND FIELD THEORY AND THE STABILITY OF TRANSITION METAL COMPOUNDS. P.George, D.S.McClure, J.S.Griffith and L.E.Orgel.
J. chem. Phys., Vol. 24, No. 6, 1269 (June, 1956).

Thermodynamic data for the formation of complexes of the transition metal ions of the 1st, 2nd, and 3rd series are interpreted in terms of ligand field stabilizations. The electronic structures of the complexes are also considered. G.Allen

541.67

8457. CALCULATION AND MEASUREMENT OF THE MAGNETIC SUSCEPTIBILITY OF ALLENE HYDROCARBONS. J. Guy, J.Tillieu, J.Hoarau, M.Gaudemar and B.Gross. C.R. Acad. Sci. (Paris), Vol. 243, No. 1, 34-5 (July 2, 1956). In French.

Using previously determined (Abstr. 5508/1956) values for the atomic susceptibilities and structural constants, the χ_M values of a series of 6 allene hydrocarbons are calculated. On comparison with the experimentally determined molar susceptibilities, values ranging from 3.15 to 5.4 are obtained for $-\lambda_{allene}$, the structural correction factor.

G.I.W.Llewelyn

CHEMICAL ANALYSIS 543/545

545.3 : 536.53

8458. A PORTABLE TEMPERATURE-CHLORINITY BRIDGE FOR ESTUARINE INVESTIGATIONS AND SEA WATER ANALYSIS. B.V.Hamon. J. sci. Instrum., Vol. 33, No. 9, 329-33 (Sept., 1956).

An instrument for the measurement of temperature and chlorinity of water in situ is described. A thermistor is used for temperature measurement, and an electrical conductivity cell, the temperature coefficient of which is compensated by means of the thermistor, is used for chlorinity. The instrument is direct reading, with ranges of 0-30°C for temperature and 0-16 p.p.t (parts per thousand) and 16-20 p.p.t. for chlorinity. The accuracy is ± 0.1 deg.C for temperature, and ± 0.05 p.p.t. for chlorinity on the higher range. When used in the laboratory as a transfer instrument, an accuracy of ± 0.02 p.p.t. in chlorinity can be obtained. A.

545.8 : 539.16

8459. SIMULTANEOUS DETERMINATION OF RADIOCHEMICAL MIXTURES. A.S.Blum. Nucleonics, Vol. 14, No. 7, 64-5 (July, 1956).

A method for the determination of the total body exchangeable Na and K by the administration of Na^{24} and K^{42}. The activities of two samples from different parts of the body are determined using counters sensitive to the radiations from both isotopes. Provided the samples contain different relative amounts of K and Na the separate specific activities of Na and K can be calculated. The method can be applied to other mixtures that can be only partially chemically separated.

R.D.Smith

CRYSTALLOGRAPHY 548

548.0 : 536.71

8460. CRYSTALLOGRAPHY AND THE PHASE RULE. A.R.Ubbelohde. Brit. J. appl. Phys., Vol. 7, No. 9, 313-21 (Sept., 1956).

Classical thermodynamics provides powerful methods for correlating various thermal parameters of a system. However, anomalies are found in the classical theory particularly for condensed phases, such as solids or liquids. A detailed study of the structure of such phases by what may be broadly termed crystallographic methods has thrown much light on the classical anomalies. The present review surveys various structural changes such as crystal lattice transformations or melting that produce increases of entropy and thus can favour thermodynamic transitions in solids. Particular attention is directed towards the structural elucidation of the following anomalies: (i) Pre-transition and pre-melting phenomena. In many cases these can now be attributed to gradual structural changes within a crystal of the same kind as the discontinuous jump at a transition. (ii) The occurrence of smeared or continuous thermodynamic transitions, which are sometimes described as transitions of "higher order". These can often now be attributed to the coexistence of regions of two slightly different structures or sub-units within a hybrid single crystal. Reference is made to some of the techniques of study that have been used to investigate such coexistence. (iii) The occurrence of hysteresis around a thermodynamic transition. This can arise from the same coexistence phenomena that lead to smeared thermodynamic transitions. Precision studies on single crystals of the kinds described seem likely to throw much light on thermodynamic transitions in solids. A.

548.1

8461. THE GEOMETRICAL BASIS OF CRYSTAL CHEMISTRY. VI. A.F.Wells. Acta cryst., Vol. 9, Pt 1, 23-8 (Jan., 1956).

For Pt V see Abstr. 4213 (1955). In Pt 1 (Abstr. 11526/1954) it was stated that the only three-dimensional 3-connected nets of the n^3 type are 8^3, 9^3, and 10^3, and that there are two different nets corresponding to the symbol 8^3 and similarly for 10^3. It is now shown that there are also nets 7^3, as well as further nets 8^3, 9^3, and 10^3. These new nets are derived in a systematic way and illustrated. A.

548.5

8462. GROWTH FEATURES ON CRYSTALS OF LONG-CHAIN COMPOUNDS. II. S.Amelinckx. Acta cryst., Vol. 9, Pt 1, 16-23 (Jan., 1956).

For Pt I, see Abstr. 10060/1955. Growth features observed on crystals of the orthorhombic modification of the n-alcohols $C_{22}H_{43}OH$, $C_{24}H_{49}OH$ and $C_{26}H_{53}OH$ are described. They consist of interlaced spirals of two types. The influence of the presence of imperfect dislocations on the growth patterns is discussed. It has been possible to conclude that growth round an imperfect dislocation in a crystal of the orthorhombic modification of the n-alcohols does not produce a polytype. The normal stacking is continued; this causes certain complications in the growth pattern. The growth of twinned crystals of n-alcohols and monocarboxylic acids (behenic, eikosanic and lignoceric acid) is considered. A growth mechanism for ordinary twins and for certain polysynthetic twins is proposed. A.

548.5

8463. GROWTH FEATURES ON CRYSTALS OF LONG-CHAIN COMPOUNDS. III. S.Amelinckx. Acta cryst., Vol. 9, Pt 3, 217-24 (March, 1956).

Interlaced patterns have been observed on a monoclinic form of the paraffin $C_{34}H_{70}$, on behenic acid and on the α-form of the n-alcohols $C_{34}H_{47}OH$. The patterns are analysed using the method outlined in Pt I (Abstr. 10060/1955), and deductions are made concerning the stacking sequences of the crystals on which they are observed. It is found that in crystals of tetratriacontane and behenic acid successive growth layers can be turned through 180°, and that this kind of stacking fault is responsible for the growth of polytypic crystals. It is further shown that growth round imperfect dislocations in behenic acid does not produce polytypes, but that, on the contrary, the normal structure is continued. An interlaced pattern, observed

on a crystal of the α-form of the n-alcohols, is also interpreted in terms of the stacking of successive layers. This pattern is the first example of a "doubly interlaced pattern", i.e. an interlacing of two patterns which are themselves interlaced. A.

548.5 : 537.312.5

8464. PREPARATION OF SINGLE CRYSTALS OF InAs AND GaAs. R.Gremmelmaier.
Z. Naturforsch., Vol. 11a, No. 6, 511-13 (June, 1956). In German.

Crystals are prepared by drawing from the melt using a seed crystal but the graphite crucible containing the raw materials is enclosed in a sealed quartz tube which also contains the drawing system, this being raised by a magnetic device. R.F. heating is used for the melt with a wire-wound furnace over the rest of the tube. GaAs crystals are more difficult to grow and show zones of crystal misalignment. Good crystals sometimes show a resistivity of 5×10^7 ohm.cm and give an open circuit photovoltage of 0.8 V with a closed circuit current density of 8 mA/cm^2. G.F.J.Garlick

548.52

8465. THE GROWTH MECHANISM OF COPPER OXIDE CRYSTALS AT HIGH TEMPERATURE. A.I.Andrievskiĭ and M.T.Mishchenko.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 1, 81-3 (1956). In Russian.

A plate of Cu_2O was heated for 157 hours at 1020° C and changes in grain boundaries were sought. Photomicrographs showed that in the last 67 hours of the heating only very slight changes occurred. Some small grains were absorbed in their neighbours and the total grain-boundary length in the area examined decreased from 104 mm to 81 mm. A.L.Mackay

548.572

8466. DENSITIES OF TRIGONS AND ULTRA-VIOLET ABSORPTION OF DIAMONDS. A.Halperin.
Acta cryst., Vol. 9, Pt 3, 265-8 (March, 1956).

Two opposite faces of each of 37 small transparent octahedral diamonds were examined microscopically by phase-contrast illumination for the density of trigons on them. Ultraviolet absorption edges were also determined for the same diamonds. The two faces of the same diamond were found usually to have about the same density of trigons. On all the diamonds the faces examined could be classified into two groups with regard to the density of trigons. These results support a conclusion reached previously that critical conditions of growth exist for the initiation of trigon formation. Analysis of the results, including the ultraviolet absorption edges of the diamonds examined, indicates that the ultraviolet absorption might be correlated with the surface texture shown by the trigons. A.

ATOMIC AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

8467. ON THE DEFINITION OF IONIC RADII. H.G.Heide.
Z. phys. Chem. (Leipzig), Vol. 205, No. 3, 167-74 (Jan., 1956). In German.

The present day position with regard to ionic radii (in crystals) is critically discussed, it being emphasized that the division of the sum of the ionic radii into the single radii cannot always be considered as valid. W.Good

548.7

8468. TWO-CENTER INTEGRALS FOR BODY-CENTERED IRON USING ATOMIC FUNCTIONS WITH EXCHANGE. M.Suffczyński.
Acta phys. Polon., Vol. 15, No. 2, 111-15 (1956).

Two-centre integrals for metallic body-centred iron have been calculated using the new atomic wavefunctions computed by J.H.Wood taking into account the exchange effects. The integrals turn out to be about twice as small as those based on the wavefunctions without exchange. A.

548.7

8469. THE LATTICE ENERGIES OF THE ALKALI HALIDES. D.F.C.Morris.
Acta cryst., Vol. 9, Pt 2, 197-8 (Feb., 1956).

These have been recalculated from up-to-date thermodynamic data using the Born–Haber cycle, and also, for some of the crystals, using the heats of sublimation and the heats of dissociation of the gas molecules. These two independent methods not only agree with each other, but also with the best theoretical values to within the expected accuracy of ± 2-3 kcal/mole. K.W.Plessner

548.7

8470. POINT CHARGE INTERACTION ENERGY IN IONIC CRYSTALS. T.I.Liberberg-Kucher.
Zh. éksper. teor. Fiz., Vol. 30, No. 4, 724-33 (1956). In Russian.

A microscopic calculation of the interaction energy of two charges located in an ionic crystal has been carried out. The ions were considered to be fixed at the lattice points and only the non-inertial polarization component of the crystal was taken into account. The result depends on the sign of the charges and for charges located at a large distance from each other the interaction is of the Coulomb type. If the charges are located in neighbouring ions the result differs from the Coulomb value on the average by 17-20%. Polarization energy of the crystal due to the field of a point charge located in one of the lattice points was computed for KCl using the same approximation. A.

548.7 : 539.11

QUANTUM THEORY OF COHESIVE PROPERTIES OF SOLIDS. See Abstr. 7562

548.7 : 539.11

THE POTENTIAL ENERGY AND THE ELASTICITY OF THE CRYSTALLINE MEDIUM. See Abstr. 7563

548.7

8471. SELF-ENERGY OF SLOW POLARON AND VARIATIONAL METHOD. E.Haga.
Progr. theor. Phys., Vol. 13, No. 5, 555-7 (May, 1955).

A variational method is used which gives substantial improvement on the results of Lee, Low and Pines (Abstr. 4475/1953) for intermediate coupling, and in close agreement with the exact solution of Gross (Abstr. 1999/1952) for the one dimensional case. P.T.Matthews

548.7

8472. CONTRIBUTION TO THE THEORY OF POLARON MOBILITY. K.B.Tolpygo and Z.I.Uritskiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 5, 929-37 (1956). In Russian.

The interaction between a polaron in translational motion and the lattice oscillations and the resulting polaron energy losses are investigated. On basis of a classical treatment the energy transferred from the polaron to the vibrational degrees of freedom of the lattice are computed. This mode of generation of vibrations is possible in the acoustical case only if the polaron velocity exceeds the velocity of sound in the crystal. Thus, one has here an analogue of the Cherenkov effect for an electron moving with a velocity exceeding that of light. The quantitative results obtained with NaCl, KCl and KBr indicate that although this slowing down mechanism is not the main one the interaction between the current carriers and acoustical and transverse optical vibrations in the indicated crystals is nevertheless quite significant. A.

548.7 : 539.11

INVESTIGATIONS IN THE THEORY OF THE ENERGY LEVELS OF ELECTRONS IN IDEAL AND PERTURBED CRYSTAL LATTICES. See Abstr. 7568

548.7

8473. SYSTEMATIC ABSENCES CORRESPONDING TO FALSE SYMMETRY. D.H.Templeton.
Acta cryst., Vol. 9, Pt 2, 199-200 (Feb., 1956).

Systematic absences may not always indicate screw axes or glide planes but can also be caused by special arrangements of atoms. If, for example, the atoms are divided into sets each of which have positions related to different but parallel glide planes, there could be systematic absences without the presence of a glide plane for the whole assembly. A.E.De Barr

548.7

8474. THE STRENGTH OF LOMER–COTTRELL SESSILE DISLOCATIONS. A.N.Stroh.
Phil. Mag. (Ser. 8), Vol. 1, No. 6, 489-502 (June, 1956).

A Lomer–Cottrell sessile dislocation at the head of a piled-up group of dislocations may give way under the combined action of stress and temperature. Depending on its orientation relative to the group, the dislocation may yield either by recombining and slipping on a (100) plane or by dissociating into the two dislocations from which it was formed. The size of the group required for both these mechanisms is obtained as a function of stress, but the results depend rather sensitively on the structure of the dislocation core. A.

548.7

8475. CONTINUOUS DISTRIBUTIONS OF DISLOCATIONS. III. B.A.Bilby and E.Smith.
Proc. Roy. Soc. A, Vol. 236, No. 1207, 481-505 (1956).

For previous part, see Abstr. 9239 (1955). It is shown that the general equations of the theory of Nye are applicable in full only when the lattice curvature (and so also the dislocation density) is small. The correct equations for large curvatures are formulated. The relation between the fundamental node theorem of dislocation theory and certain theorems of the theory of generalized space is considered in some detail. It is also shown that when the lattice lines of the dislocated crystal are treated as a system of independent congruences of curves, the tensor describing the local dislocation density may be expressed in terms of certain invariants connected with the system of congruences. For the rotation case, a relation between the dislocation density and Ricci's coefficients of rotation is derived. A.

548.7

8476. IONIC DISORDER IN X-IRRADIATED KBr CRYSTALS. H.RUchardt.
Phys. Rev., Vol. 103, No. 4, 873-6 (Aug. 15, 1956).

The production X-rays of anion vacancies in KBr crystals was studied quantitatively in the liquid helium temperature range. The thermal stability of the vacancies was investigated in detail. A series of recombination steps was observed in the 10^{0} K to 30^{0} K region associated with activation energies of the order of 0.03 to 0.09 eV. A green luminescence was observed during the irradiation by X-rays and during the annealing of the crystals. This luminescence is attributed to electronic recombinations rather than to vacancy recombination. A semi-quantitative electrostatic model is proposed to explain the very limited thermal stability of single vacancies. This analysis predicts remarkably high local concentrations of vacancies. A.

548.7

8477. CORRELATION EFFECTS IN DIFFUSION IN CRYSTALS. A.D.LeClaire and A.B.Lidiard.
Phil. Mag. (Ser. 8), Vol. 1, No. 6, 518-27 (June, 1956).

It is a feature of many atomic diffusion jump mechanisms that successive jumps of an atom are "correlated" in the sense that the direction of a jump is not completely at random but is influenced to some extent by the direction of the preceding jump or jumps. General formulae are derived for the diffusion coefficient which take account of this correlation. The theory is applied to a calculation of the diffusion coefficient of solute atoms by the Johnson mechanism. A.

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.73 : 548.74

8478. ANOMALOUS ABSORPTION OF SLOW NEUTRONS AND X-RAYS IN NEARLY PERFECT SINGLE CRYSTALS. J.W.Knowles.
Acta cryst., Vol. 9, Pt 1, 61-9 (Jan., 1956).

Two nearly perfect calcite crystals were set in the parallel arrangement of a two-crystal neutron spectrometer and the γ-rays from neutron capture by the calcium of the second crystal, which was 2 in. thick, were measured with a NaI scintillation detector. A maximum change in γ-ray intensity of $2.5 \pm 0.6\%$ occurred near the angle of Laue reflection. An application of the dynamical diffraction theory gave a "dispersion curve" variation with angle for the γ-ray intensity. This theory agreed quantitatively with the experimental observation. In a second experiment concerning a search for anomalous absorption of neutrons incident at the Bragg angle, the transmission of neutrons by a 2 mm thick cadmium sulphate crystal was measured and compared with the transmission of X-rays. The incident radiations (1.30 A neutrons and 0.708 A X-rays) were selected by reflection from calcite crystals. When the 2 mm crystal was set near the position of Laue reflection the X-ray transmission increased from 1.5×10^{-4} to 4.5×10^{-4} but the neutron transmission decreased from 3.3×10^{-2} to 2.9×10^{-2}, this decrease being equal to the reflected intensity. Both observations may be explained by postulating a mosaic block size of 0.4 mm in the cadmium sulphate crystal. A.

548.73

8479. ON CERTAIN COMPOUNDS OF THE M_2O_3-Cu_2O TYPE. C.Delorme.
Acta cryst., Vol. 9, Pt 2, 200 (Feb., 1956). In French.

548.733

8480. THE LAUE GONIOMETER AND ITS USE AS A PROPORTIONAL DIFFRACTOMETER. A.R.B.Skertchly.
Acta cryst., Vol. 9, Pt 3, 320-1 (March, 1956).

548.735

8481. THE PROBABILITY DISTRIBUTION OF X-RAY INTENSITIES. VII. SOME SESQUISYMMETRIC DISTRIBUTIONS. A.J.C. Wilson.
Acta cryst., Vol. 9, Pt 2, 143-4 (Feb., 1956).

For Pt VI, see Abstr. 9263 (1955). This note is related to Pt V (Abstr. 8079/1953). It has been shown that parallel repetition of a motif through non-crystallographic symmetry, in addition to crystallographic centrosymmetry $\bar{1}$, leads to a set of intensity distributions (hypercentric distributions) whose variance is greater than that of the familiar centric distribution. If now further crystallographic symmetry is present, such as m or mm, the variance is reduced to a value intermediate between that of the centric (V_1) and that of the appropriate hypercentric distribution (V_n). If the multiplicity of the asymmetric unit is 2p, the variance is in fact $V^{(p)} = V_1 + p^{-1}(V_n - V_1)$. Series for determining numerical values of the sesquicentric distributions are discussed. A.

548.735

8482. A METHOD FOR THE DIRECT DETERMINATION OF THE POSITION OF MOLECULES IN ORGANIC CRYSTALS FROM THE INTENSITIES OF DIFFRACTION REFLECTIONS. A.M.Liquori and A.Ripamonti.
Ricerca sci., Vol. 26, No. 5, 1442-50 (May, 1956). In Italian.

A method is described for determining the coordinates of molecular centres with respect to the origin of the unit cell of a crystal. After a formulation of the principles on which this method is based, its application by means of a "photographic synthesis" is described. The method is particularly useful during the preliminary stage of a structure determination, and is more advantageous than previously described methods since an exact knowledge of the scale factor of the diffraction amplitudes or of the molecular structure and orientation is not required. An application to the structure of $\alpha + \alpha'$ dipyridyl is given. For this purpose the molecules of this compound are considered as made of regular hexagons which are treated crystallographically as independent. By employing the molecular Fourier-transform of henzene, both the orientation and the position of these hexagons in the crystal have been established. The results have been found to agree closely with those obtained by means of Fourier projection of the electron density. A.

548.735.46

8483. AN APPLICATION OF THE DIFFERENCE-PATTERSON METHOD. V.Sasisekharan.
Proc. Indian Acad. Sci. A, Vol. 43, No. 4, 224-30 (April, 1956).

This technique is applied to a complicated example, namely, the isomorphous crystals, di-p-tolyl telluride and di-p-tolyl selenide, whose structures have been recently reported. It is shown that the method can be confidently applied in general to isomorphous crystals, even though the replaceable atoms may slightly differ in their positions. Also, Buerger's vector set method is applied to the Patterson projections of the di-p-tolyl selenide along b- and c-axes. It is shown that Buerger's method can be profitably used when there is no appreciable overlap in the projection and if the heavy atoms or the replaceable atoms do not have special values for their parameters. A.

548.736.1

8484. ON THE NATURE OF EXTRA REFLECTIONS IN THE LAUE PHOTOGRAPHS OF SOME DIAMONDS OF KNOWN RELATIVE FLUORESCENCE EFFICIENCIES. S.C.Sirkar and S.N.Sen.
Indian J. Phys., Vol. 30, No. 1, 29-35 (Jan., 1956).

The positions and approximate relative intensities of extra spots accompanying the {111} reflection in the Laue photographs of eleven specimens of diamond have been determined using a Seifert X-ray tube provided with a copper target and nickel filter and running at 30 kV, 28 mA. In order to measure the directions of extra reflections accurately in some cases the front surface of the crystals as dusted with powdered NaCl, so that the Debye-Scherrer pattern of NaCl was superimposed on the Laue photographs. The specimens studied were used by Bishui (1950, 1952) in previous investigations on the relative intensities of the fluorescence band at 4156 A and on the ultraviolet absorption limits. The results show that all the specimens excepting D6 possess partial mosaic structure, so that they produce extra reflections from {111} planes of different intensities in the direction making an angle $2\theta_B$ with the incident rays when the disorientation from the Bragg angle θ_B is less than 3^0. It is observed that neither the intensities of the extra reflections nor those of the extra reflections in other directions present in the Laue photographs of some of the crystals can be correlated either with the intensity of the band at 4156 A or with the impurity present in the crystals. Also, these intensities cannot be correlated with the respective thicknesses of the specimens. A.

548.736.1

8485. THE X-RAY DIAGRAM OF FIBROUS SULFUR. J.A.Prins, J.Schenk and P.A.M.Hospel.
Physica, Vol. 22, No. 8, 770-2 (Aug., 1956).

The diagram is a superposition due to two modifications of which one is soluble in CS_2. Both components are found to be stable for at least a year, whereas Meyer and Go (Helvetica Chimica Acta, Vol. 17, 1081, 1934) stated that their fibrous sulphur was unstable. A.R.Stokes

548.736.3

8486. REFINEMENT OF THE P—P BOND LENGTH IN P_4S_7. A.Vos and E.H.Wiebenga.
Acta cryst., Vol. 9, Pt 1, 92-3 (Jan., 1956).

By computing the three-dimensional electron-density distribution around P_1 and P_2 a more reliable value was obtained for the P—P bond length than the authors' previous (1955) value; viz. 2.35 A, standard deviation assumed 0.01 A. J.Adam

548.736.3

8487. THE BINDING IN NiAs AND Fe_3C. H.Schenk and U.Dehlinger.
Z. Naturforsch., Vol. 11a, No. 4, 327 (April, 1956). In German.

For NiAs type lattices there is a directed prismatic six-fold coordination between A and B atoms and the A atoms lie on a simple hexagonal lattice with eight-fold coordination; for Fe_3C the A atoms have twelve-fold coordination. E.P.Wohlfarth

548.736.4

8488. THE STRUCTURE OF RHOMBOHEDRAL T(NiCuAl). M.G.Bown.
Acta cryst., Vol. 9, Pt 1, 79-4 (Jan., 1956).

Crystals of the ternary compound in the Ni-Cu-Al system have been examined by single-crystal X-ray methods. Two distinct forms were found, one having a rhombohedral, the other a cubic, unit cell. In both forms the heavy and light atoms are arranged as in a CsCl-type structure; ordered vacancies in heavy-atom sites give rise to the two different superlattices. The rhombohedral unit cell contains ideally 8 Al and 6 heavy atoms; in the crystals examined there are also random vacancies in the heavy-atom sites, and possibly in the Al sites. The relationship between the two forms is considered briefly. A.

548.736.4

8489. THE UNIT CELL AND SPACE GROUP OF BARIUM TETRATITANATE, $BaO.4TiO_2$. F.W.Harrison.
Acta cryst., Vol. 9, Pt 2, 198 (Feb., 1956).

The unit cell is orthorhombic with dimensions a = 3.79, b = 14.51, c = 6.30 A. From the observed density (4.6 g/cm^3) it appears that there are 2 formula units per unit cell. The space group is either P-mn, Pm-n or Pmmn. K.W.Plessner

548.736.4 : 535.343

CRYSTAL STRUCTURE OF BRUCITE AND PORTLANDITE IN RELATION TO INFRARED ABSORPTION.
See Abstr. 7294

548.736.6

8490. NOTATION FOR FELSPAR STRUCTURES. H.D.Megaw.
Acta cryst., Vol. 9, Pt 1, 56-60 (Jan., 1956).

548.74

8491. A NEUTRON-DIFFRACTION STUDY OF SODIUM SESQUICARBONATE. G.E.Bacon and N.A.Curry.
Acta cryst., Vol. 9, Pt 1, 82-6 (Jan., 1956).

548.74 : 538.221 : 621.318.132

8492. NEUTRON-DIFFRACTION STUDIES OF THE MANGANESE-MAGNESIUM FERRITE SYSTEM. R.Nathans, S.J.Pickart, S.E.Harrison and C.J.Kriessman.
Proc. Instn Elect. Engrs, Paper No. 2182 R, publ. Oct., 1956, 4 pp. To be republished in Vol. 104 B (1957).

Several compositions of mixed manganese-magnesium ferrite, $Mg_yMn_{1-y}Fe_2O_4$, have been examined by neutron diffraction in order to determine the distribution of the Mn cations and the position of the oxygen anions in the spinel lattice. The compounds chosen, with y = 0.25, 0.50, 0.75 and 0.90, were quenched from both 1400° and 1000° C. For all the samples dealt with the results indicate that the distribution of the Mn cations is appreciably unaltered, i.e. approximately 90% of the Mn present remains fixed in the tetrahedral sites. The average bond length in the tetrahedral site for the various compositions, as determined from the oxygen position and the unit cell size, has been found to decrease, relative to the sum of the bonding ions, with increasing concentration of Mn. This change may be interpreted as a measure of the covalent bonding of the cations occupying these sites. On this basis, continued substitution of Mn for Mg results in a greater covalent bonding on the tetrahedral sites, and an estimate has been made of the relative covalent bonding strengths of Mn^{2+} and Fe^{3+}. A.

GEOPHYSICS 55

550.380

8493. THE CRUST AS THE POSSIBLE SEAT OF EARTH'S MAGNETISM. J.S.Chatterjee.
J. atmos. terrest. Phys., Vol. 8, No. 4-5, 233-9 (May, 1956).

The crust of the earth is discussed as a possible seat of the magnetization of the earth. It is shown that the temperature and pressure to which the crust (a thickness of about 20 km) of the earth is subjected, will make its magnetic mineral contents (e.g. magnetite) highly permeable. The shell can thus be magnetically saturated by a field of very low intensity of the order of 0.01 gauss. It is suggested that the magnetizing field is provided by the "ring current" formed in the space round the earth, during worldwide magnetic storms, as a result of the encounter of the solar neutral corpuscular beams (consisting of an equal number of positive and negative charges) with the earth-magnet. It is shown that an initially existing field of even one-hundredth of the present field is enough to build up the magnetization of the crust to saturation. An explanation of the secular variation is also suggested as caused by the ring current trying to follow (with a lag) the wobbling motion of the magnetic axis round the geographical axis due to the diurnal rotation of the earth. A.

550.385 : 523.745 : 537.591.5

CORRELATION AMONG MAGNETIC STORMS, SOLAR PHENOMENA AND COSMIC-RAY STORMS. See Abstr. 7507

550.385 : 523.755

SOLAR CORONA AND GEOMAGNETISM. See Abstr. 7107

550.510.535

8494. THE FADING OF RADIO WAVES OF FREQUENCIES BETWEEN 16 AND 2400 kc/s. S.A.Bowhill.
J. atmos. terrest. Phys., Vol. 8, No. 3, 129-45 (March, 1956).

The lowest ionosphere, which reflects low-frequency radio waves, contains irregularities of ionization which cause fading of these frequencies. The irregularities have been studied by three types of experiment, all of them using c.w. transmissions reflected from the ionosphere at nearly vertical incidence during the night-time. Firstly, fading records over the frequency range 16-200 kc/s show shallow fading, with a substantially constant quasi-period of 7 minutes up to 70 kc/s; above this frequency a rapid fading of quasi-period about 1 minute appears as well, increasing in depth till it dominates the slower fading. Secondly, two receivers tuned to 85 kc/s separated by various distances give fading records whose statistical correlations lead to structure sizes at the ground of 5 km for the slow fading and 1 km for the fast fading. Thirdly, records taken at three receivers at right angles at 70 kc/s show that the slow fading is due mainly to random velocities of about 40 metres/sec at the reflecting layer, together with a smaller drift velocity which is very variable. These results lead to a suggested model, with small irregularities slightly above the 70 kc/s reflection level, together with large irregularities below this level. A.

551.311.123 : 539.501

8495. KAOLIN MODEL GLACIERS. W.V.Lewis and M.M.Miller.
J. Glaciol., Vol. 2, 533-8 (Oct., 1955).

A mixture of approximately one part of water to two parts of kaolin (china clay) has proved suitable for making model glaciers on scales between 1 : 1000 and 1 : 10 000. The kaolin "glaciers" crevasse and flow realistically, and slide on their beds. They serve well for qualitative demonstrations, and some simple preliminary quantitative experiments suggest that they may also be useful for this purpose. A.

551.46

8496. PHYSICS IN OCEANOGRAPHY. K.F.Bowden.
Brit. J. appl. Phys., Vol. 7, No. 8, 273-81 (Aug., 1956).

Review article. Some examples of the development or adaptation of physical methods for research at sea are described, with the results they have given in problems such as those of waves, storm surges and ocean currents. A.

ATMOSPHERE. METEOROLOGY 551.5

551.501.8

8497. INTERPRETATION OF THE HEIGHT-VERSUS-TIME PRESENTATION OF RADAR ECHOES. V.G.Miles.
J. Meteorol., Vol. 13, No. 4, 362-8 (Aug., 1956).

The height-versus-time presentation of radar echoes (used with radars of 1.25 and 0.86 centimetre wavelength) is a record of the precipitation and of some of the clouds passing directly over the radar. Such a record corresponds to a "surface of observation" in the atmosphere. For non-precipitating clouds, the shape of the surface depends upon the upper-wind patterns; for precipitating clouds, the surface is a vertical plane. Many of the recorded precipitation echoes have a marked slope, due to the effect of wind shear on falling precipitation particles. The magnitude of slope appears to be determined mainly by the speed of travel of the precipitation column, the wind shear, and the fall speed of the particles; lesser influences are the change of wind direction with height, horizontal dimension of the column, and the path of the column relative to the radar position. The horizontal distribution of particle sizes may be very important, but not enough is known about this factor to permit an estimate of its effect on the shapes of echo boundaries. In practical use of this radar system for weather observation, it does not appear that any purpose would be

PA

served by making measurements of echo slope. Probably the chief value of the system lies in the qualitative information it furnishes about the current physical processes of cloud and precipitation. An important question arises as to the size of geographical area adequately represented by the height-time observations. A.

551.508

8498. HANDBOOK OF METEOROLOGICAL INSTRUMENTS. Pt I. INSTRUMENTS FOR SURFACE OBSERVATIONS.
London: Her Majesty's Stationery Office (1956). 458 pp.

Provides a comprehensive account relating to the design, installation, operation, maintenance and performance of all instruments used at different types of British Meteorological Office stations, and includes some information about other types of instruments which illustrate various principles. It is concerned solely with ground observations, but includes details of instruments for use at sea as well as on land. In general the decisions and recommendations of the World Meteorological Organisation relating to instrument practice have been followed. For many stations the instruments must be in continuous operation and in some cases in all types of weather and distant from workshops with facilities for repair. For these reliability, simplicity of design, ease of reading and manipulation, robustness and durability are more important than for other instruments which can be used at observatories. This applies particularly to recording instruments and a wide range is thus necessary. The accuracy and sources of error of the instruments are dealt with and their limitations in use explained. Individual chapters deal with the measurement of atmospheric pressure, temperature, humidity, surface wind, precipitation, evaporation, sunshine, starshine, intensity of solar radiation, and visibility and the making of cloud observations. A useful section relates to the methods of transport of instruments to avoid damage. The book is fully illustrated with 132 diagrams and 53 plates to show details of the instruments. A comprehensive bibliography and index are provided. R.S.Read

551.508.79 : 551.596

8499. THEORY OF THE ROCKET-GRENADE METHOD OF DETERMINING UPPER-ATMOSPHERIC PROPERTIES BY SOUND PROPAGATION. G.V.Groves.
J. atmos. terrest. Phys., Vol. 8, No. 4-5, 189-203 (May, 1956).

The problem is considered of determining the wind field and velocity of sound in the upper atmosphere as a function of height by means of sound propagation from grenades exploded at these heights. Observations made are taken to be the location and time of each explosion, and the times of arrival of each resulting sound-wave at a number of microphones at known points on the ground. The distribution of microphones is taken to be quite general, within a region of the earth's surface over which horizontal variations in the wind and sonic velocities can be neglected. Differences in the heights of the microphones, which would arise from topographical features and the curvature of the earth, are taken into account. The wavefront from each explosion is taken to be propagated at a known Mach number at any time, so that account can be taken of the departure of the Mach number from unity along any ray. The nature of the problem requires the solution to proceed by successive approximation in terms of the variations in the wind components and speed of sound. The theory is developed as far as the second-order solution, and this is thought to be adequate for practical needs. It is shown that four microphones are, in general, sufficient for the determination of the three components of the wind-velocity and the speed of sound. By using more than four microphones, a least-squares determination is possible, and this would allow a check to be made on the consistency of the observations and the adequacy of the theory. Finally, it is shown how atmospheric pressure, density, and temperature can be deduced from these determinations, assuming the composition of the atmosphere to be known. A.

551.510.535 : 621.396.11

8500. A PROCEDURE FOR THE ROUTINE DETERMINATION OF THE TRUE DISTRIBUTION OF ELECTRON DENSITY IN AN IONOSPHERIC LAYER FROM THE PENETRATION ABSORPTION OF THIS LAYER. W.Becker.
Arch. elekt. Übertragung, Vol. 10, No. 5, 207-14 (May, 1956). In German.

A method is described for deciding quickly, from a knowledge of the variation with frequency of the orderly apparent height in a sweep-frequency recording, whether the sounded ionospheric layer is of Epstein, cosine-shaped, or parabolic character, and for determining, as a result, the true height of its maximum and its electron content. In its application the new method is similar to the earlier Booker-Seaton method and approximately of the same rapidity. Unlike the former it takes into account, not only a parabolic make-up, but also an Epstein and cosine make-up of the layer and the influence of the terrestrial magnetic field. Also in contrast to the earlier Booker-Seaton method, the new method determines in a differential manner the half-thickness of the sounded ionospheric layer, so that the influence of any deeper layers on this characteristic quantity can be greatly reduced. The influence of the restricted frequency range of an ionospheric echo-sounding system on this characteristic quantity is precluded in the same manner, unlike the earlier Booker-Seaton method. On comparison, it is revealed that neglect of the terrestrial magnetic field in determining the true height of the maximum of an ionospheric layer results in a variation of the latter with the limit frequency so as to simulate possibly a diurnal variation. A quantitative-error discussion of the earlier Booker-Seaton method is given. A.

551.510.535 : 538.566.3

8501. THE INTERACTION OF PULSED RADIO WAVES IN THE IONOSPHERE. J.A.Fejer.
J. atmos. terrest. Phys., Vol. 7, No. 6, 322-32 (Dec., 1955).

Preliminary daytime measurements of radio-wave interaction in the lower ionosphere with pulse transmitters are described. Interpretation of the results with the aid of the theory of Bailey and Martyn (1934-35) yields the collision frequency, the electron density, and the energy-loss coefficient G. The resulting collision frequencies are in substantial agreement with results based on laboratory measurements by Crompton, Huxley, and Sutton (1953), and with a value obtained from the observation of partial reflections by Gardner and Pawsey (1953). The electron densities are near the values of Gardner and Pawsey. The value obtained for G is very much higher than those resulting from laboratory measurements (Crompton, Huxley, and Sutton, 1953). The latter apply, however, to high excess electron energies, while the excess electron energy during the present measurements was low. The results of the observations described in this paper appear to lend support to the original form of the theory of Bailey and Martyn and not to its alternative development recently suggested by Huxley (1953). A.

551.510.535

8502. IONOSPHERIC WIND DETERMINATION FROM SPACED RADIO RECEIVER FADING RECORDS. G.W.G.Court.
J. atmos. terrest. Phys., Vol. 7, No. 6, 333-40 (Dec., 1955).

A simple physical model provides an interpretation of the fading records obtained when using the system described by Mitra (1949) for the observation of drift in the ionosphere. This seems to be confirmed by a new practical method of analysis of the records, and the results support a proposal for an alternative method of determining the winds. A brief survey of the proposals and initial experimental results are presented. A.

551.510.535 : 550.38

8503. THE INFLUENCE OF THE GEOMAGNETIC FIELD ON TURBULENCE IN THE IONOSPHERE. J.W.Dungey.

. atmos. terrest. Phys., Vol. 8, No. 1-2, 39-42 (Feb., 1956).

If turbulent motion of the neutral particles occurs in the onosphere, it may be influenced by the geomagnetic field. It s shown that electromagnetic damping is negligible for the maller eddies. In the higher regions the electrons are constrained to move nearly parallel to the magnetic field, and his results in variations of electron density, even when the lensity of neutral molecules does not vary. These variations re probably appreciable above 100 km. A.

551.510.535

8504. THE Z PROPAGATION HOLE IN THE IONOSPHERE. G.R.Ellis.

. atmos. terrest. Phys., Vol. 8, No. 1-2, 43-54 (Feb., 1956).

The occurrence of F-region triple-splitting allows the properties of an unusual propagation hole in the ionosphere to be examined experimentally. Two methods of estimating the angular size of the hole are discussed. The first is based on the beam effect of Z echoes, according to which Z echoes are returned to the ground in a narrow beam. The second follows from an analysis of the distribution of angle of arrival of Z echoes. It is found at Hobart that, with a wave frequency of 4.65 Mc/s, the hole is approximately circular with an angular width to half-power points of less than 0.84°. Under certain circumstances the propagation hole provides a means by which waves can pass completely through an otherwise reflecting ionospheric layer. A.

551.510.535 : 523.164

8505. THE SPECTRUM OF RADIO-STAR SCINTILLATIONS AND THE NATURE OF IRREGULARITIES IN THE IONOSPHERE. J.P.Wild and J.A.Roberts.

J. atmos. terrest. Phys., Vol. 8, No. 1-2, 55-75 (Feb., 1956).

An observational study of the spectrum of radio-star scintillations has been made with a view to exploring the small-scale structure of the ionosphere. Observations of the intense source in Cygnus were made near transit at an altitude of about 15°. Three instruments were used simultaneously: (1) a swept-frequency spectroscope to record the dynamic spectrum of scintillations, (2) a swept-frequency interferometer to study positional deviations at different frequencies, and (3) a triangular spaced-aerial system for studying the lateral size and motion of the pattern on the ground. The commonly occurring types of dynamic spectra are described, and their interpretation in terms of ionospheric phenomena is discussed. From the nature of the spectra it is inferred that most of the fluctuations are due to focusing by single lens-like irregularities, rather than to diffraction at a large number of irregularities. The spectra also show that the scintillation patterns are often dispersed across the ground, different frequencies being focused at different points. This is tentatively attributed to ionospheric gradients which act like huge prisms. Such "dispersing regions" may lie at different levels from the "focusing regions". The degree of fluctuation shows two maxima, one near midnight (winter) and the other near midday (summer). The size, shape, and motion of the pattern on the ground, as well as the dispersion, also vary throughout the year. In many cases the pattern on the ground is highly elongated, a feature which complicates the determination of the direction and speed of motion. For daytime conditions at least, this elongation indicates marked anisotropy in the ionospheric irregularities. A.

551.510.535

8506. THE DAILY AND ANNUAL VARIATIONS OF F_1-IONIZATION AND THEIR INTERPRETATION. O.Burkard.

J. atmos. terrest. Phys., Vol. 8, No. 1-2, 83-90 (Feb., 1956). In German.

The simple relation between the critical frequencies of the F_1-layer and the position of the sun — shown by the formula $(f_0F_1)^2 = C^2 \cdot (\cos\chi)^x$ — suggests a rather primitive law for the layer formation. This supposition has been verified. The relation mentioned is easy to explain if a linear increase of temperature with height is assumed for the F_1-layer, and if the recombination coefficient is — very tentatively — assumed to have the form $\alpha = \alpha_0 \cdot p^k \cdot T^n \cdot N^m$. The constants k, n and m are partly evaluated from the ionospheric observations, but a study of the possible recombination processes would be necessary to clarify the problem completely. Research concerning the possible temperature conditions yields a model which shows a temperature gradient smaller in summer than in winter. Accordingly, the whole warm layer has a bigger thickness in summer and therefore extends over a greater height-interval than in winter. A model where the increase of temperature starts at the same height in winter and in summer (and the gradient in summer is greater than in winter) does not agree with the observations. A.

551.510.535

8507. THE FADING PERIODS OF THE E-REGION COUPLING ECHO AT 150 kc/s. R.W.Parkinson.

J. atmos. terrest. Phys., Vol. 8, No. 3, 158-62 (March, 1956).

Studies have been made on the fading periods of pulsed 150 kc/s waves returned from the coupling region in the lower ionosphere. Two dominant distributions of the fading periods have been found, centred on two different frequencies, yielding information regarding the diffracting region responsible for the observed fading. A.

551.510.535

8508. THE DETERMINATION OF THE HORIZONTAL VELOCITY OF IONOSPHERIC MOVEMENTS FROM FADING RECORDS FROM SPACED RECEIVERS. D.W.G.Chappell and C.L.Henderson.

J. atmos. terrest. Phys., Vol. 8, No. 3, 163-8 (March, 1956).

Ratcliffe has shown that, for the Mitra formula for the velocity of ionospheric movements to be valid, a long sample of fading record is necessary. This paper presents a method of deriving the velocity which is not dependent on a long sample of record, and is valid for any arbitrary distribution of orientation of "lines of maximum amplitude". The derived formula is compared with Mitra's formula, and the time delays from a fading record are analysed. The method is not suitable for use with Philips records. A.

551.510.535

8509. A DETERMINATION OF IONOSPHERIC WINDS FOR A 24-HOUR PERIOD. G.W.G.Court and E.S.Gilfillan.

J. atmos. terrest. Phys., Vol. 8, No. 3, 169-70 (March, 1956).

Results are given of an analysis, by the method proposed in a recent paper (Court, 1955), of the radio field strength fading records obtained from the Mitra experiment (Mitra, 1949) during the 24-hour period on 17 January 1953. The date chosen was arbitrary, and the results indicate a possible diurnal effect in the variation of wind direction during that period. A.

551.510.535

8510. OBSERVATIONS OF SHORT BURSTS OF SIGNAL FROM A DISTANT 50 Mc/s TRANSMITTER. B.H.Briggs.

J. atmos. terrest. Phys., Vol. 8, No. 3, 171-83 (March, 1956).

Describes observations of short bursts of signal received at Cambridge from the Kirk o' Shotts television transmitter at a distance of about 500 km. The following characteristics are studied: (i) the statistics of the time intervals between bursts, (ii) the waveforms and durations of the bursts, and (iii) the irregular fluctuations or "fading" during the bursts. It is concluded that the majority, if not all, of the bursts are reflections from ionized trails produced by meteors, and that many of the trails which produce bursts are situated near to the receiving point, rather than near the midpoint of the transmission path. A.

551.510.535

8511. SPREAD F-LAYER ECHOES AND RADIO-STAR SCINTILLATION. R.W.Wright, J.R.Koster and N.J.Skinner.
J. atmos. terrest. Phys., Vol. 8, No. 4-5, 240-6 (May, 1956).

Observation of radio-star scintillations made at University College of the Gold Coast, Achimota, and spread F-layers made at University College, Ibadan, Nigeria, have been compared. Considerable correlation is found, although there is 510 km between the two stations, and the ionospheric observations are made entirely at vertical incidence. The diurnal and seasonal variations of the presence of spread F-layers are examined. It is found that these depend considerably on the degree of magnetic disturbance. In particular, at Ibadan in winter on disturbed days there is only a quarter of the scatter that occurs on quiet days. A.

551.510.535

8512. OBSERVATIONS AND ANALYSIS OF IONOSPHERIC DRIFT. D.G.Yerg.
J. atmos. terrest. Phys., Vol. 8, No. 4-5, 247-59 (May, 1956).

Observations of radio fading at spaced receivers for 2.33 Mc/s and 4.57 Mc/s indicate that the ionospheric drift is more variable in winter than summer. Average speeds are 19 m/sec for 2.33 Mc/s records and 12 m/sec for 4.57 Mc/s records. Fading resulting from random changes is always significant. Random changes appear to be anisotropic and tend to rotate the correlation ellipse to a position along the magnetic field. The ellipse almost invariably is oriented with the major axis in the SW quadrant. The method of similar fades is less reliable than the correlation method in evaluating drift velocities and directions. A.

551.510.535

8513. THE FORMATION OF THE IONOSPHERIC LAYERS F-1 AND F-2. J.A.Ratcliffe.
J. atmos. terrest. Phys., Vol. 8, No. 4-5, 260-9 (May, 1956).

Detailed investigations of the electron distribution in the F-2 region have recently shown (Ratcliffe et al., 1956) that the F-2 layer could be formed by the ionizing agency which has its peak of electron production in the F-1 layer, if the loss-coefficient varies with height in a certain way, explained in the paper referred to. The implications of a loss-coefficient varying in this way are examined in detail in the present paper, and it is shown that it would explain the known facts about the splitting of the F layer into separate F-1 and F-2 layers. The question of what determines the height of the F-2 electron peak is also discussed. A.

551.510.535 : 523.75

8514. THE GREAT SOLAR FLARE OF FEBRUARY 23, 1956 AND ASSOCIATED IONOSPHERIC EFFECTS AT AHMEDABAD. K.R.Ramanathan, R.V.Bhonsle, K.M.Kotadia and R.G.Rastogi.
Proc. Indian Acad. Sci. A, Vol. 43, No. 5, 306-8 (May, 1956).

551.510.535

8515. MOVEMENTS OF IRREGULARITIES IN THE E-REGION. T.Obayashi.
Rep. Ionosphere Res. Japan, Vol. 9, No. 2, 105-13 (1955).

Movements of large-scale irregularities in the E-region have been deduced from the observations of fading patterns of medium radio waves transmitted from the three broadcasting stations spaced about 150 km at the vertices of a right triangle, as received at Hiraiso situated 350-400 km apart. The speeds and directions of movement are determined by the time difference of each record, which can be observed as the transit of some characteristics on fading patterns caused by the travelling of large scale irregularities from one propagation path to another. Observations were carried on every day from July to December 1954. The movements appear to have flowed predominantly towards the west during the night and the east during the morning, with velocities ranging from 5 to 150 m/sec. The examination of the results for NS and EW components for the winter suggests the presence of the diurnal variation of direction. The average vector of movements during the night is also found to exhibit some seasonal change. By comparing the simultaneous records of ionospheric observation (vertical incidence) with the fading records of three separated points of reflection, it has been found as an example that the moving cloud, which is observed as very rapid fading with the duration of a few hours, has some correlation with the sporadic ionization cloud, and its turbulent velocities are of the order of 10 - 15 m/sec. A.

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE.
See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.521.1

8516. AN INSTRUMENT FOR MEASURING ABSORPTIVITIES FOR SOLAR RADIATION. H.Tabor and I.T.Steinberger.
J. sci. Instrum., Vol. 33, No. 9, 356-8 (Sept., 1956).

An instrument and method for measuring solar absorptivities of prepared metal samples is described. By means of comparing the cooling and heating cycles, when subjected to solar radiation, of a sample plate of which one side is a standard black and the other is the test surface, most of the usual errors are eliminated and a direct comparative measure of absorptivity obtained. A.

551.521.326

8517. NITROGEN OXIDES AND THE AIRGLOW. M.Nicolet.
J. atmos. terrest. Phys., Vol. 7, No. 6, 297-309 (Dec., 1955).

The chemospheric processes lead to various possibilities for description of the contribution of nitrogen oxides in the airglow. An excitation of the Vegard–Kaplan system is indicated when nitric oxide is formed by a three-body collision process involving molecular nitrogen. A bimolecular association leading to nitrogen peroxide must show a continuous airglow during dark hours as well as in a sunlit atmosphere. Electronic systems emission of NO_2 is also possible because of a reaction between ozone and nitric oxide. A reaction leading to an excitation of the O_2 red atmospheric band system with its peculiar emissions is also discussed. Since these various processes causing day, twilight, and night airglow occur in the mesosphere and at the mesopause level, dynamic effects may lead to strong variations in the airglow. A.

551.521.326

8518. THE HEIGHT OF EMISSION OF THE 5577 LINE OF THE AIR-GLOW AS OBSERVED ON THE JUNGFRAUJOCH. H. Elsässer and H.Siedentopf.
J. atmos. terrest. Phys., Vol. 8, No. 3, 222-32 (May, 1956).
In German.

Observations of the intensity-variation of [O I] 5577 between zenith and horizon at Jungfraujoch in winter 1954-55 with a photoelectric photometer, using the method of V.Rhijn, are discussed. Reduced with individual values of the extinction-coefficient for each observing night, they give a mean altitude of 90 ± 10 km for the luminous layer. A.

551.521.326

8519. ORIGIN OF THE MEINEL HYDROXYL SYSTEM IN THE NIGHT AIRGLOW. D.R.Bates and B.L.Moiseiwitsch.
J. atmos. terrest. Phys, Vol. 8, No. 6, 305-8 (June, 1956).

It is contended that the arguments which have been advanced against the ozone hypothesis are invalid, and that the vibrationally excited oxygen hypothesis, which has been advocated as an alternative, is unacceptable. A.

551.521.326

8520. PHOTOELECTRIC STUDIES OF THE NIGHT SKY LIGHT. IV. M.Huruhata, H.Tanabe and T.Nakamura.
Rep. Ionosphere Res. Japan, Vol. 9, No. 3, 136-47 (1955).

For Pt III, see Abstr. 9842 (1954). Two sets of the photo-

lectric photometer for surveying the 5577 A emission in the hole sky were made and observations have been carried out ince the autumn of 1953 at two stations — one at Izu Peninsua, the other at Hokkaido, 1100 km apart — for the purpose of l) studying the drifting of the night air-glow in a wider area, nd (2) studying the height of the emitting layer by triangulaion. The drifting of the night air-glow was observed on alost every observed night, resembling the previous result eported in Pt III. One result of triangulation giving a height f nearly 300 km was obtained. A.

551.557 : 551.596

521. INTRODUCTORY THEORY FOR UPPER ATMOS-HERE WIND AND SONIC VELOCITY DETERMINATION BY OUND PROPAGATION. G.V.Groves.
. atmos. terrest. Phys., Vol. 8, No. 1-2, 24-38 (Feb., 1956).

The problem is considered of deriving the mean values of he horizontal wind velocity components u(z), v(z) and the elocity of sound c(z), averaged with respect to height z along sound-ray travelling between two known points in the atmosphere, from measurements of the time of travel of the ray etween these points and the co-ordinates of the ray. It is hown that, for a ray which does not suffer total reflection, xpressions can be derived for $\overline{u(z)}$, $\overline{v(z)}$, and $\overline{c(z)}$ in terms f the measured quantities, and the mean value of the vertical omponent of wind velocity w(z), provided the variations in (z), v(z), w(z) and c(z) with height are sufficiently small. he theory is carried further by working out in detail the econd order contributions to $\overline{u(z)}$, $\overline{v(z)}$ and $\overline{c(z)}$ which arise rom the variations in u(z), v(z), w(z) and c(z). Using ypical atmospheric data, the more important of these second-rder terms are evaluated numerically for the case of a sound-ay received at an observation point on the ground from a ource at any height up to 90 km. It is shown that the contributions from these terms to $\overline{u(z)}$, $\overline{v(z)}$ and $\overline{c(z)}$ are less than .8 m/sec when the ray lies near the vertical. For a ray which eparts appreciably from the vertical (inclination about 45°), he contributions amount to a few metres per second, but are nlikely to exceed about 8 m/sec unless exceptionally large ind velocities are present. A.

551.576.1 : 551.594

522. DROPLET-ELECTRIFICATION PROCESSES AND OAGULATION IN STABLE AND UNSTABLE CLOUDS. R.Gunn.
. Meteorol., Vol. 12, No. 6, 511-18 (Dec., 1955).

The fundamental electromechanics of droplet electrification and coagulation within stable and unstable clouds is investigated. The analysis shows that atmospheric ions formed by cosmic rays or other means normally diffuse on to cloud droplet and electrify them. A nearly Gaussian distribution is established in which about half of the droplets in any selected volume of a stable cloud acquire a positive charge that is typically eleven electronic units, while the other half is negative. More than 95% of the droplets of a typical cloud are electrified. When droplet association is negligible, an equipartition is established between the thermal kinetic energy of the droplets and their electrical potential energy. In an unstable cloud, these electrified droplets mechanically associate by relative motion in the gravitational field. Thus, the growing droplets accumulate charge and a statistical distribution of highly charged droplets is established. Expressions are derived for the distribution and for the mean statistical charge on the associated droplets. Equal numbers of positive and negative droplets are normally produced, but systematic charging due to unequal ionic conductivities sometimes results in marked electrification of a single sign. The influence of droplet electrification upon cloud stability is considered. The droplet charges normally have a detectable, but not important, direct effect upon the coagulation rate of the cloud. The indirect effects, however, may be large. Electric fields of appreciable magnitude always accompany precipitation as a result of drop-charge separation. Expressions are derived for the electrical coagulation of clouds immersed in an electrical field. It is shown that electrical coagulation may exceed that due to gravitation whenever the environmental electric field is 2 statvolts per centimetre or larger. Since fields this large are commonly observed in thunderstorms, the resulting precipitation rates are correspondingly large. A.

551.593.5

8523. DAY SKY BRIGHTNESS TO 220 km. O.E.Berg.
J. geophys. Res., Vol. 60, No. 3, 271-8 (Sept., 1955).

The brightness of the daytime sky has been measured using rocket-borne stereocameras. An upper limit of 0.0075 candle/ft^2 was found for the brightness at altitudes ranging from 80 to 220 km. This limit is consistent with the brightness being due entirely to Rayleigh scattering. No evidence of high altitude clouds was found. A.

551.593.9

8524. ON THE INTENSITY AND POLARISATION OF THE LIGHT FROM THE SKY DURING TWILIGHT. J.V.Dave and K.R.Ramanathan.
Proc. Indian Acad. Sci. A, Vol. 43, No. 2, 67-78 (Feb., 1956).

Results are presented of new measurements of zenith-sky brightness and polarization in twilight made on Mt. Abu (24° 26' N : 72° 43' E) with photomultiplier and six narrow-cut colour filters for solar depressions from 0° to 20° Between 6° and 16°, secondary scatter of light from the sunward side of the twilight hemisphere becomes increasingly important; and the polarization tends to a rather constant value around 50-55%. D.R.Barber

551.594.1

8525. ON THE DEVIATIONS OF THE COURSE OF ELEMENTS OF ATMOSPHERIC ELECTRICITY ON CONTINENTS FROM THE WORLDWIDE COURSE. R.Mühleisen.
J. atmos. terrest. Phys., Vol. 8, No. 3, 146-57 (March, 1956).

Extensive recordings of atmospheric electricity were carried out with transportable instruments in towns, on their borders, and far away from settlements, with the object of ascertaining the causes of the deviations of the diurnal courses of potential gradient and air-earth current from the worldwide course on the oceans. The causes were found to be mainly positive space charges, produced at many places chiefly by urbanization, industry and traffic. These space charges are carried away many kilometres and distributed by air movements. The results were obtained by measurements made directly at the sources of disturbance, and by laboratory experiments. They preclude further conclusions from most ground measurements of atmospheric electricity. It seems advisable to carry out future measurements only at strictly selected places, possibly on tops of mountains, or to record not only two elements — potential gradient and air-earth current — but (inevitably with rather expensive equipment) also the electrical space charge density, if possible, at various altitudes. This method should enable the worldwide functions of the elements of atmospheric electricity to be better determined. A.

551.594.12 : 551.594.5

8526. SECONDARY PROCESSES DUE TO ABSORPTION OF THE LYMAN LINES EMITTED FROM AURORAE. A.Omholt.
J. atmos. terrest. Phys., Vol. 9, No. 1, 28-35 (July, 1956).

The processes considered are the ionization of nitric oxide in the lower ionosphere by the HLα line, and the excitation of O I λ8446 by resonance absorption of the HLβ line. Comparison with the intensity of HLα emitted from the quiescent sun suggests that HLα emitted from aurora may give an appreciable contribution to the ionization, but not the full amount required for polar blackouts. The excitation of

O I λ8446 by absorption of HLβ is found to be unimportant in ordinary aurorae. A.

551.594.12 : 551.510.535

8527. NEGATIVE OXYGEN IONS IN THE UPPER ATMOSPHERE: THE AFFINITY AND RADIATIVE ATTACHMENT COEFFICIENT OF ATOMIC OXYGEN. L.M.Branscomb and S.J.Smith.

Trans Amer. Geophys. Un., Vol. 36, No. 5, 755-8 (Oct., 1955).

The influence of negative ions of atomic oxygen on the physics of the ionosphere and night airglow is re-examined in the light of new experimental determinations of the oxygen affinity (1.48 ± 0.10 eV) and photodetachment cross-section. The radiative attachment coefficient is calculated from the photodetachment cross-section. There is no evidence of a resonance at the threshold, where the attachment coefficient is approximately 1.2×10^{-15} cm^3/sec. A.

551.594.14

8528. ARTIFICIAL RADIOACTIVE PRODUCTS IN THE ATMOSPHERE. G.Schumann.

Z. angew. Phys., Vol. 8, No. 8, 361-4 (1956). In German.

Using a cylindrical β-counter, the time dependence of the activity is $t^{-(1+x)}$, where $x \cong 0.1$. This means that the explosion time can be found by extrapolation of the reciprocal activity vs. time curve. The maximum activity found by the filter method at Heidelberg was of the order of 10^{-14} curie/m^3. J.M.Hough

551.594.21 : 551.576.1

8529. INITIAL ELECTRIFICATION PROCESSES IN THUNDERSTORMS. R.Gunn.

J. Meteorol., Vol. 13, No. 1, 21-9 (Feb., 1956).

Thunderstorm-electrification processes that develop in clouds which are everywhere above the freezing temperature have been analysed. Nearly equal numbers of highly electrified positive and negative raindrops are formed by the association of large numbers of cloud droplets, and these themselves are statistically electrified by ionic diffusion. The observed charges carried by both cloud droplets and rain are therefore a manifestation of the ion pairs produced in the free atmosphere primarily by cosmic rays and radioactivity. The discharge characteristics of nearly equal numbers of oppositely electrified drops are determined for drops falling through an atmosphere wherein the positive and negative ionic conductivities are different. It is found that the differential discharge of highly charged rain falling in such an environment systematically separates positive and negative electricity and establishes a distribution that accounts quantitatively for thunderstorms of low to moderate intensity. Useful expressions are developed for the convected free-charge current density established by the process. The analysis leads to a quantitative description of the principal observed features of thunderstorm electrification. A.

551.594.5

8530. DOUBLE-DOPPLER RADAR INVESTIGATIONS OF AURORA. A.G.McNamara.

J. geophys. Res., Vol. 60, No. 3, 257-69 (Sept., 1955).

A pulsed double-Doppler radar technique has been employed to study the 90.7 Mc/s signals reflected from auroral ionization. A spectrum analyser was used in conjunction with the radar to measure the power spectra of the auroral echoes. The Doppler data are compared with observations of the visible aurora and with simultaneous echoes on 56 and 106 Mc/s non-coherent high-resolution radar equipment. An interpretation of the Doppler data is given, and several theoretical models of the reflection mechanism are examined in terms of their effect on the observed spectra. A.

551.594.5

8531. A THEORY OF SCATTERING BY NONISOTROPIC IRREGULARITIES WITH APPLICATION TO RADAR REFLECTIONS FROM THE AURORA. H.G.Booker.

J. atmos. terrest. Phys., Vol. 8, No. 4-5, 204-21 (May, 1956).

A model of the distribution of ionization in an aurora is developed that can explain the aspect sensitivity of radar echoes obtained at v.h.f. during auroral activity. Even when the radar is in the midst of a zone of auroral activity, echoes are obtained only from low angles of elevation in roughly the northern quadrant. However, both the horizontal and vertical angles over which echoes are obtained increase significantly as frequency is decreased from 100 to 25 Mc/s. These observations can be explained in terms of columns of ionization parallel to the earth's magnetic field. The size of the columns must, however, be much smaller than suggested by Chapman (1952) or by Booker, Gartlein and Nichols (1955). The column size required is of the order of 40 m in length and 1 m in diameter, smoothed so as to avoid discontinuities at the surfaces. It is quite doubtful whether the formation of such short columns of ionization can be associated directly with the formation of visual rays, even though the same axis of symmetry is involved in both cases. The size of irregularities required to explain the observations is in fact of the order of magnitude likely to be involved in atmospheric turbulence, and it is quite likely that the earth's magnetic field could create substantial nonisotropy in the associated irregularities of electron density. Thus the strength of auroral echoes and their aspect sensitivity could be entirely explained as back-scatter arising from non-isotropic atmospheric turbulence in an E region having a maximum electron density about a hundred times the normal value. Simple turbulence cannot, however, explain the remarkable fading phenomena associated with auroral reflections (Bowles, 1954). A.

551.596 : 551.593 : 538.566.2

8532. THE PROPAGATION OF WAVES IN A MEDIUM WITH RANDOM NON-UNIFORMITIES OF REFRACTIVE INDEX. V.A.Krasil'nikov.

Akust. Zh., Vol. 2, No. 2, 107-12 (April-June, 1956). In Russian.

The review is concerned with the problem of waves and fluctuations in connection with atmospheric acoustics, hydroacoustic atmospheric optics and radiowave propagation in the troposphere. Among matters discussed are: the simple wave equations, effect of small non-uniformities, modification and solution of the equation for such conditions, diffraction effects, turbulent medium and its effects, micro-structure of a wind, the structural function of the temperature field, phase, amplitude shift in fluctuations. 23 refs. (21 Russian). C.R.S.Manders

BIOLOGY 57/59

578.088.5 : 539.16.08

8533. THE SITE OF DEPOSITION OF Y^{91} IN THE BONES OF RABBITS AND DOGS. J.Jowsey, H.A.Sissons and J.Vaughan.
J. nuclear Energy, Vol. 2, No. 3, 168-76 (March, 1956).

The authors describe the sites of deposition of Y^{91} in the bones of normal rabbits and of normal and rachitic puppies. The retention and excretion of both Sr^{90} and Y^{91} in normal and rachitic puppies following a single intravenous injection of the two isotopes is also reported. The retention of Sr^{90} and Y^{91} was high and of the same order in both groups for as long as seven days after injection. Autoradiographic studies showed a different pattern of deposition for Sr^{90} and Y^{91}. Sr^{90} was found in areas of active bone growth in both normal and rachitic puppies following the pattern already described for rabbit and monkey bone. Y^{91} was never found in either osteoid tissue or in areas of active calcification. It was heavily concentrated on bone surfaces where active resorption was either in progress or had just occurred and in association with small completed Haversian systems. The areas where Y^{91} was concentrated showed a strongly positive periodic acid—Schiff reaction in undecalcified sections fixed in alcohol. The apparent changes in localization of Y^{91} at varying periods after uptake, can be explained in terms of normal growth and remodelling of bone. A.

MEDICAL SCIENCE. HUMAN PHYSIOLOGY 61

612.84

8534. OPTICAL AND PHOTOELECTRIC ANALOG OF THE EYE. O.H.Schade, Sr.
J. Opt. Soc. Amer., Vol. 46, No. 9, 721-39 (Sept., 1956).

A photoelectric analogue of the visual system is constructed in conformance with anatomical data. The analogue has the form of a colour television camera chain feeding electrical signals to a "computer" (the brain). Evaluation of characteristics is limited to elements preceding the computer, and particularly to the "luminance channel" of the colour system. The primary photoelectric transfer characterisitcs $\bar{n}_1 = f(E_T)$ of the receptors (rods and cones) are computed as a function of retinal illumination (E_T) from threshold signal-to-noise ratios in the effective image area of point sources, disks, and other test objects. The effective image area, which is the convolution of the object area with the sampling area of the visual system, is determined from its Fourier spectrum. The constants of the transfer functions are established from the optical constants of the eye, its storage-time function, and the maximum transfer ratio of statistical units of the rod and cone systems. There is little room for variation of constants, if they are to remain in agreement with observed values. The incomplete d.c. restoration in the system (differentiation of edges) is taken into account as a negative image component caused by feedback. System design principles are used as a guide in calculating the signal integration by retinal elements and the relative photoconductor gain characteristics of the receptors which are part of a system of interdependent functions including the primary characteristic, the over-all transfer characteristic to the optic nerve lines, and the four spatial integration characteristics represented by the equivalent passbands of lens and retina for the rod and cone systems. The final solution is perhaps not completely unique for all functions, but does not violate or disagree with fundamental principles or observations as demonstrated by a comparison of the operating characteristic of the analogue with the Munsell lightness scale, its noise level with the perception of external noise; and its statistical transfer ratio, relative gain, gamma, and feedback with observed data. The acuity, contrast sensitivity, and threshold visibility of point sources of the analogue are, of course, in inherent agreement with corresponding properties of the eye. A.

612.843

8535. THE RELATION BETWEEN PUPIL EFFICIENCIES FOR SMALL AND EXTENDED PUPILS OF ENTRY. A.M.Ercoles, L.Ronchi and G.Toraldo di Francia.
Optica Acta, Vol. 3, No. 2, 84-9 (June, 1956).

An investigation of the apparent brightness produced by rays impinging on the same retinal area (the fovea) at different inclinations. In the measurements the photometric matching fields were illuminated by the method of Maxwellian view. Pupil efficiencies were determined for effective pupils of entry (focused images in the pupil plane) as follows: a single "pinhole", two pin-holes placed either symmetrically or asymmetrically with respect to the pupil centre, full circles and rings centred in the pupil, and finally, semicircles. The main object was to find if the observed pupil efficiency for the extended pupil of entry patterns could be derived from the observed pupil efficiencies of the parts by applying the additive law. Three observers showed different behaviour but in no case was the derived efficiency for an extended pupil of entry pattern greater than the directly observed efficiency (over-additivity). On the other hand, under-additivity does occur. A tentative theoretical explanation of under-additivity is suggested in terms of inhibition and of possible differences of inclination of the axes of the foveal cones. But it is conceivable that a component of inhibition may depend on the colour-differences which accompany the Stiles—Crawford effect. A.

612.843

8536. ZONES OF PARTIAL SUMMATION. J.Oliva and M.Aguilar.
Optica Acta, Vol. 3, No. 2, 90-3 (June, 1956). In French.

The summation of the stimuli produced by two luminous points is studied quantitatively as a function of their angular separation, at the limit of perception. The experimental results permit a study of the law governing the threshold luminance as a function of the area covered by the stimulus. A.

612.843.31

8537. COLOUR-DISTINCTION THRESHOLDS OF MACRO DETAILS OF COLOUR PHOTOGRAPHS IN TERMS OF CONCENTRATION. Yu.N.Gorokhovskiĭ and K.B.Popova.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 1, 63-6 (1956). In Russian.

The thresholds were determined by means of test plates of different degree of contrast, each of which was a slide consisting of 12 rows of differently orientated Landolt rings on a bright background. The test plates of different contrast were prepared photographically on single-layer colour films coated with separate layers of multi-layer positive colour film. The contrast of the single-colour images was determined by the difference of visual equivalent-grey densities, i.e. by the difference of the relative (reduced to greyness) surface concentrations of the dye between the dark ring and the bright background. Black-white images were also investigated. The test plates were viewed in transmitted light by 5 observers at 900 luxes. It was found that the distinction thresholds of macro details decreased in the following sequence: yellow, blue, and purple dyes, and black-white images. F.Lachman

612.843.63

8538. RESOLVING POWER OF THE EYE. M.Kornfel'd.
Zh. tekh. Fiz., Vol. 26, No. 2, 448-51 (1956). In Russian.

Let w be the probability that the eye attributes a distin-

guishing feature to the right object, while $w^* = 1 - w$, that of attributing it to the wrong object, and let the difference $u = w - w^* = 2w - 1$ be the characteristic of the degree of resolution. In the case of a finite number (n) of tests, an approximate value u' will be obtained instead of u, and (according to the integral limiting theorem of Laplace) the value $|u - u'| < t/\sqrt{n}$, where t is the statistic. The author calls $|u - u'|$ the error, and $t/\sqrt{n}$ the deviation, while p corresponding to t) is the expectation (probability) of determining the degree of resolution. It is shown that, when $u' > t/\sqrt{n}$, the objects tested are distinguishable, whereas for $u' < t/\sqrt{n}$ they are indistinguishable. Seven thousand tests were carried out, using an apparatus which is illustrated and described, with 28 persons who had to distinguish between circles whose diameters were ~ 12 mm and differed by 0.1 – 1.0 mm. The values of u', when plotted against the corresponding "features" (diameter differences), gave a curve which differed markedly from that drawn from calculations based on the existence of the insensitivity range and on the standard distribution of disturbances. F.Lachman

612.843.633 : 535.317.25

EXPERIMENTS CONCERNING THE INTERRELATIONSHIP OF RESOLVING POWER AND RECOGNITION. See Abstr. 7257

612.85

8539. SOME NEW METHODS OF MEASURING HUMAN HEARING AND RESULTS OBTAINED FROM THEM. G.V.Gershuni.
Akust. Zh., Vol. 2, No. 2, 137-41 (April-June, 1956). In Russian.

The paper discusses new methods of measuring hearing in man based on the use of his conditioned reactions to sound. It is established that the absolute threshold of hearing and the differential limits for frequency and intensity with pure tones may be measured by such reactions with the same trustworthiness as for a verbal reply. In certain cases conditioned reflexes have been discovered which are sub-threshold by 1-6 dB with respect to verbal reply. Some attention is directed to the significance of the central mechanisms in this subject. C.R.S.Manders

615.849

8540. THE DISTRIBUTION OF DOSE-RATE ACROSS THE FIELD OF AN X-RAY THERAPY TUBE. R.F.Farr.
Brit. J. Radiol., Vol. 28, 364-73 (July, 1955).

TECHNIQUE. MATERIALS 62/69

66.048 : 551.521.1

8541. ATTEMPTS TO PERFECT A SOLAR DISTILLATION APPARATUS. J.Savornin and G.Lejeune.
C.R. Acad. Sci. (Paris), Vol. 243, No. 1, 32-4 (July 2, 1956). In French.

Describes, with sketches, five experimental arrangements and compares the mean results obtained with these during the summer of 1955. F.E.Hoare

669.011 : 539.172.4

8542. PRIMARY SEPARATION PLANT AT THE WINDSCALE WORKS. H.G.Davey.
Nuclear Pwr, Vol. 1, No. 2, 53-61 (June, 1956).

Plutonium is manufactured in Britain in the two air-cooled, graphite-moderated piles of the Windscale works of the United Kingdom Atomic Energy Authority. After removal from the piles the irradiated fuel rods are first stored under water for several weeks. They are then dissolved in nitric acid and the solution passed through three towers from which streams of fission products, plutonium and uranium are obtained by solvent extraction with dibutyl carbitol. The plutonium and uranium streams undergo further purification while the fission products are concentrated and stored. The plant has a highly active section and a moderately active one and although it was at first doubted whether access even to the medium active cell would be possible, methods have since been developed for achieving this. Full details of the process are given, and some of the operational problems discussed. A.

669.04 : 539.172.4

8543. ZONE MELTING OF URANIUM. J.E.Antill.
Nuclear Pwr, Vol. 1, No. 4, 155-61 (Aug., 1956).

Zone melting experiments in a vertical furnace have shown that to remove soluble metallic elements from uranium slow zone speeds ($\frac{1}{4}$ in./hr) are necessary and density differences may be harnessed to increase the purification. The non-metallic elements carbon and oxygen may be removed at much faster zone speeds (3 in./hr). Zone melting has been considered as a modified self-slagging process for the removal of fission products from irradiated uranium. Greater decontaminations for zirconium and for total activity were obtained than in self-slagging experiments. A certain minimum concentration of carbon and oxygen is necessary to obtain the maximum elimination of fission products. A.

PHOTOGRAPHY 77

771.534

8544. THE DEPENDENCE OF THE DENSITY OF PHOTOGRAPHIC EMULSIONS ON THE ENERGY OF β-RADIATION. M.Rozkoš and V.Petržílka.
Czech. J. Phys., Vol. 6, No. 3, 237-45 (June, 1956). In Russian.

A relation was derived from which it is possible to calculate the density D of photographic emulsions caused by β-radiation, dependent on the period of radiation T, the intensity of the source J and the average energy of the particles. The derivation is based on the assumption that the density is proportional to the energy lost by the particles in the emulsion. This energy has been defined as a product of the number of particles absorbed and their average energy $\bar{E}$. The assumption that this average energy does not vary by absorption was verified experimentally. The range of the product JT, in which the densities caused by two sources of the same isotope are identical if $T_1 : T_2 = J_2 : J_1$, was also experimentally determined. The validity of the relation for D was verified by experiment. By means of three sources S^{35}, P^{32} and $Sr^{90} + Y^{90}$ (composite source both components of which were in equilibrium) the dependence of D on the product JT was determined. The measured values were compared with the theoretical curves calculated for the given source according to the relation for D. The experimental and theoretical values are in good agreement up to the value $JT = 7 \times 10^7$ β-particles, the energies of which lie in the range 0.169 MeV(S^{35}) to 2.35 MeV (Y^{90}). A

778.34

8545. APPARENT RANGE OF TRACKS IN NUCLEAR EMULSIONS. T.A.Brody.
Rev. Mexicana Fís., Vol. 4, No. 4, 224-31 (Oct., 1955). In Spanish.

An approximate correction formula, previously obtained empirically, for the effect of background density on track length in nuclear emulsions, is confirmed experimentally. A.